Figure 2.6-14 East Range Alternate HVTL Route 1 Along 38L Route: Segment 2

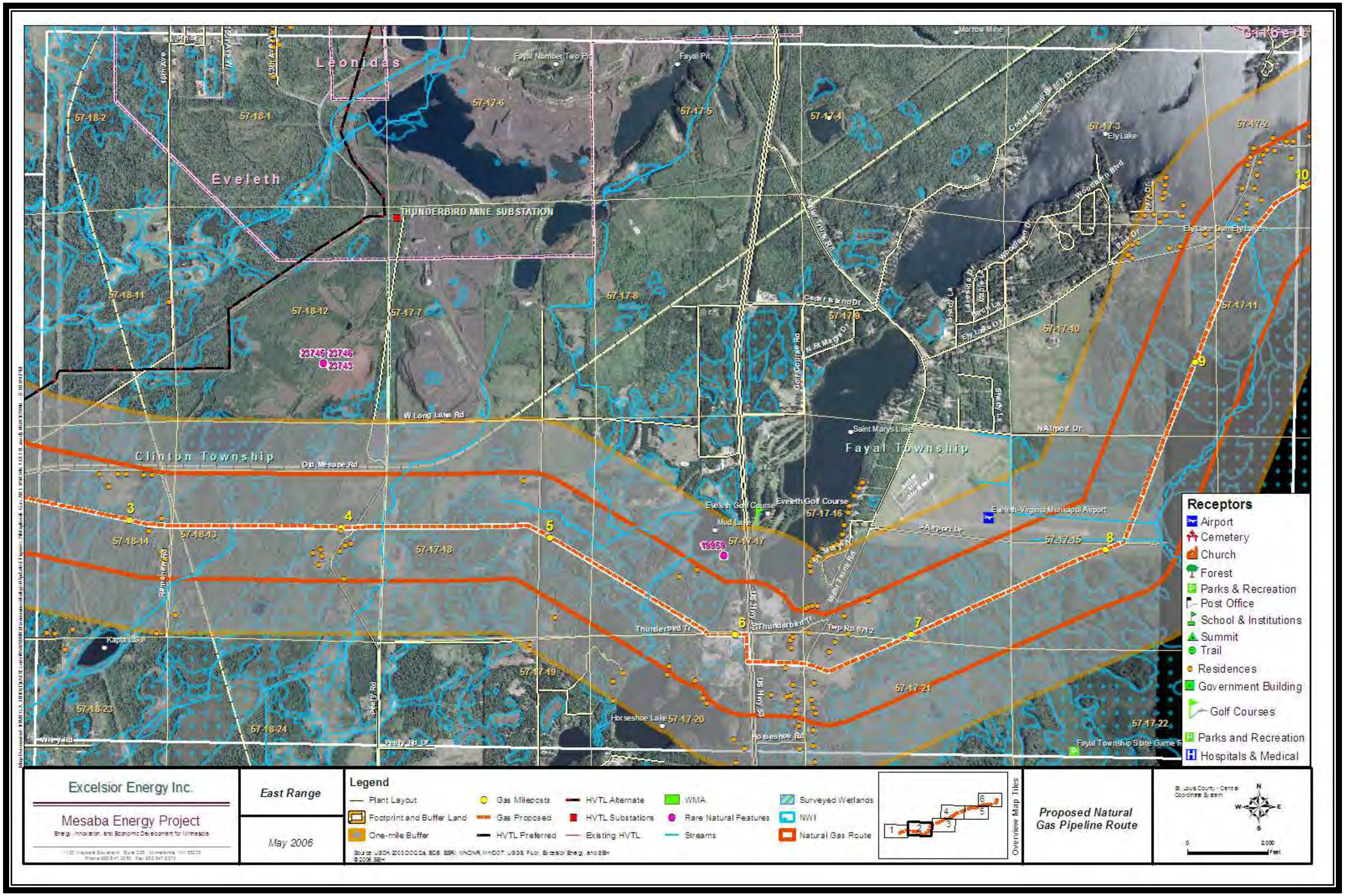


Figure 2.6-15 East Range Alternate HVTL Route 1 Along 38L Route: Segment 3

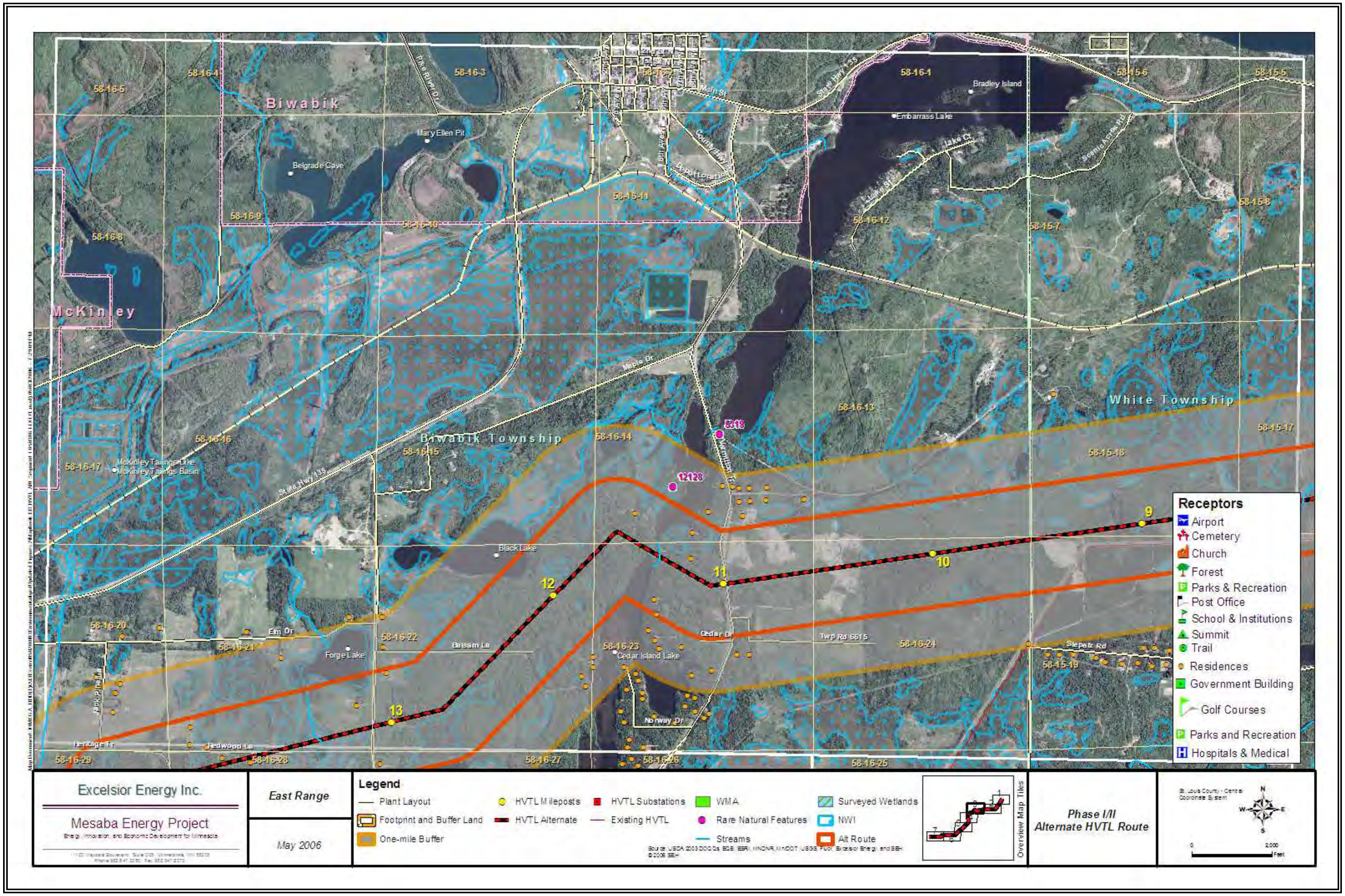


Figure 2.6-16 East Range Alternate HVTL Route 1 Along 38L Route: Segment 4

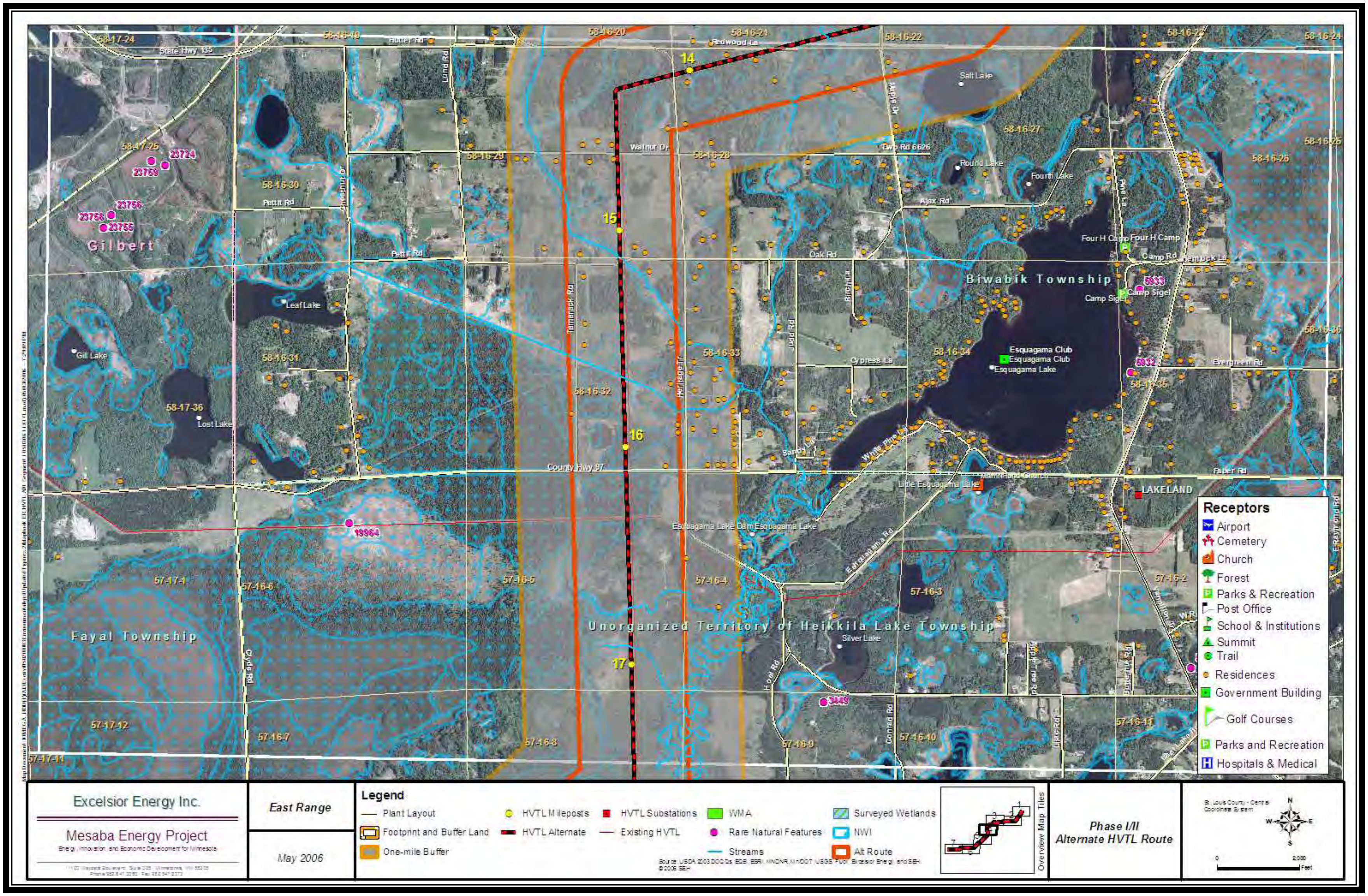


Figure 2.6-17 East Range Alternate HVTL Route 1 Along 38L Route: Segment 5

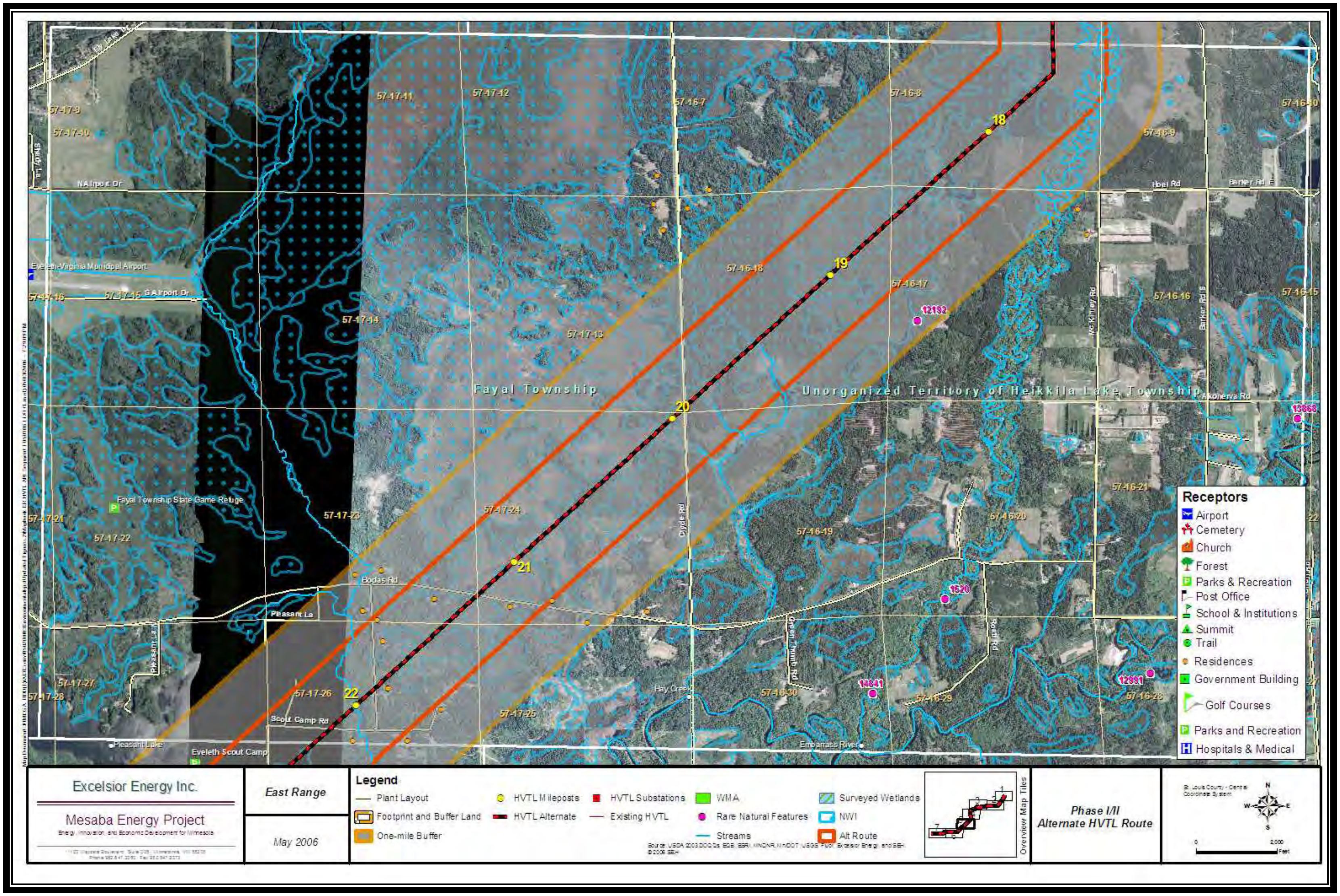


Figure 2.6-18 East Range Alternate HVTL Route 1 Along 38L Route: Segment 6

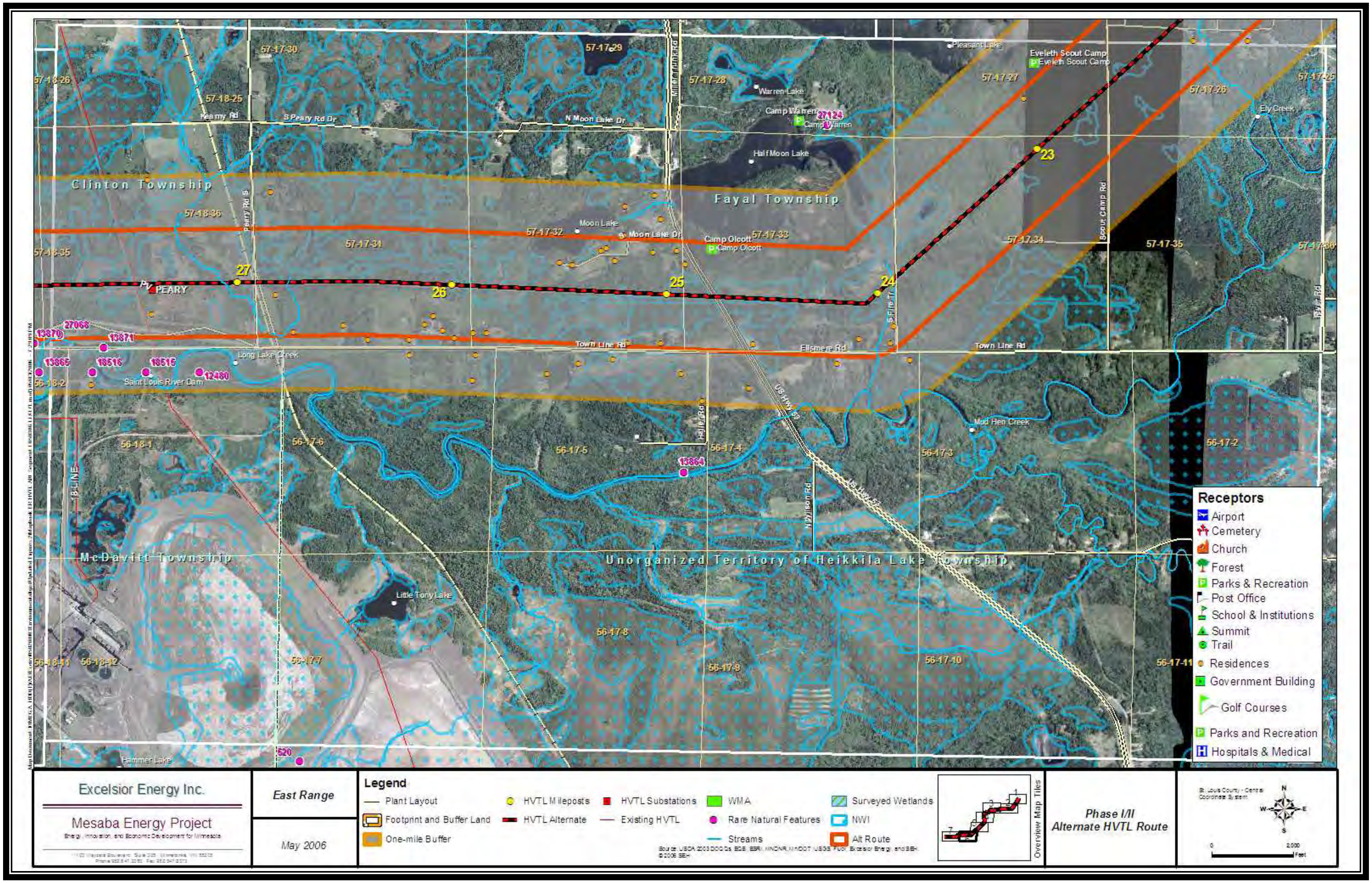
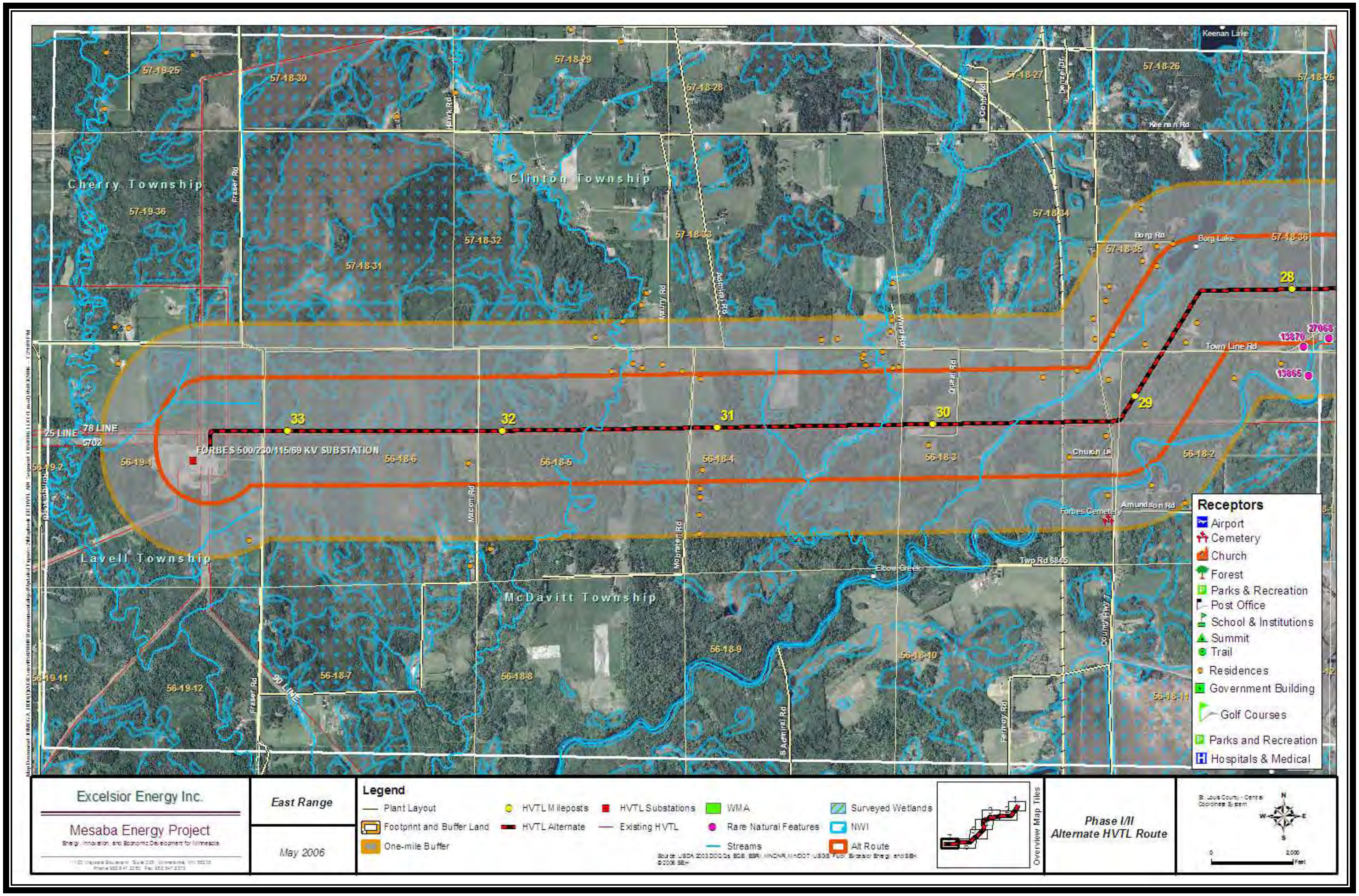


Figure 2.6-19 East Range Alternate HVTL Route 1 Along 38L Route: Segment 7



2.6.4 Natural Gas Pipeline Route

NNG represents the only feasible option for supplying Mesaba One and Two with natural gas as it is the only pipeline company within the immediate vicinity of the East Range Site. NNG's existing pipeline serves CE (and the former LTV mining operation) and abuts the IGCC Power Station Footprint on its eastern boundary. The diameter of the NNG pipeline at the point of its interconnection near Carlton, Minnesota with the GLG pipeline is 20-inches. From Carlton, NNG's line generally travels northward until it reaches the junction of St. Louis CR 454 and CR 315 about one mile west of Iron Junction, Minnesota. From there, the pipeline branches into two pipelines. One of the two branches is a 12" pipeline that serves the Hibbing area, and the second is a 10" branch line that travels past the eastern boundary of the East Range Buffer Land to serve Cliffs Erie. In order to provide natural gas in the quantity and at the pressure required to supply the Project's two phases, the following will be required:

- Installation of approximately 33 miles of new, 16-24-inch pipe placed alongside the existing 10-inch branch line now serving CE.
- Addition of a new compressor at the existing point where the GLG and NNG pipelines interconnect.
- Installation of an ultrasonic meter facility to serve IGCC Power Station.

Figures 2.6-18 through 2.6-24 present an overview of NNG's existing natural gas pipeline route from the pipeline tap near Iron Junction, Minnesota to the IGCC Power Station. Significant receptors are shown along the pipeline route in the series of figures presented. Table 8.2-2 shows the number of residences and special receptors (churches, hospitals, cemeteries, etc.) located within a one-half mile band on each side of the centerline of the Proposed Natural Gas Pipeline Route.

Figure 2.6-20 East Range Natural Gas Pipeline Milepost Map

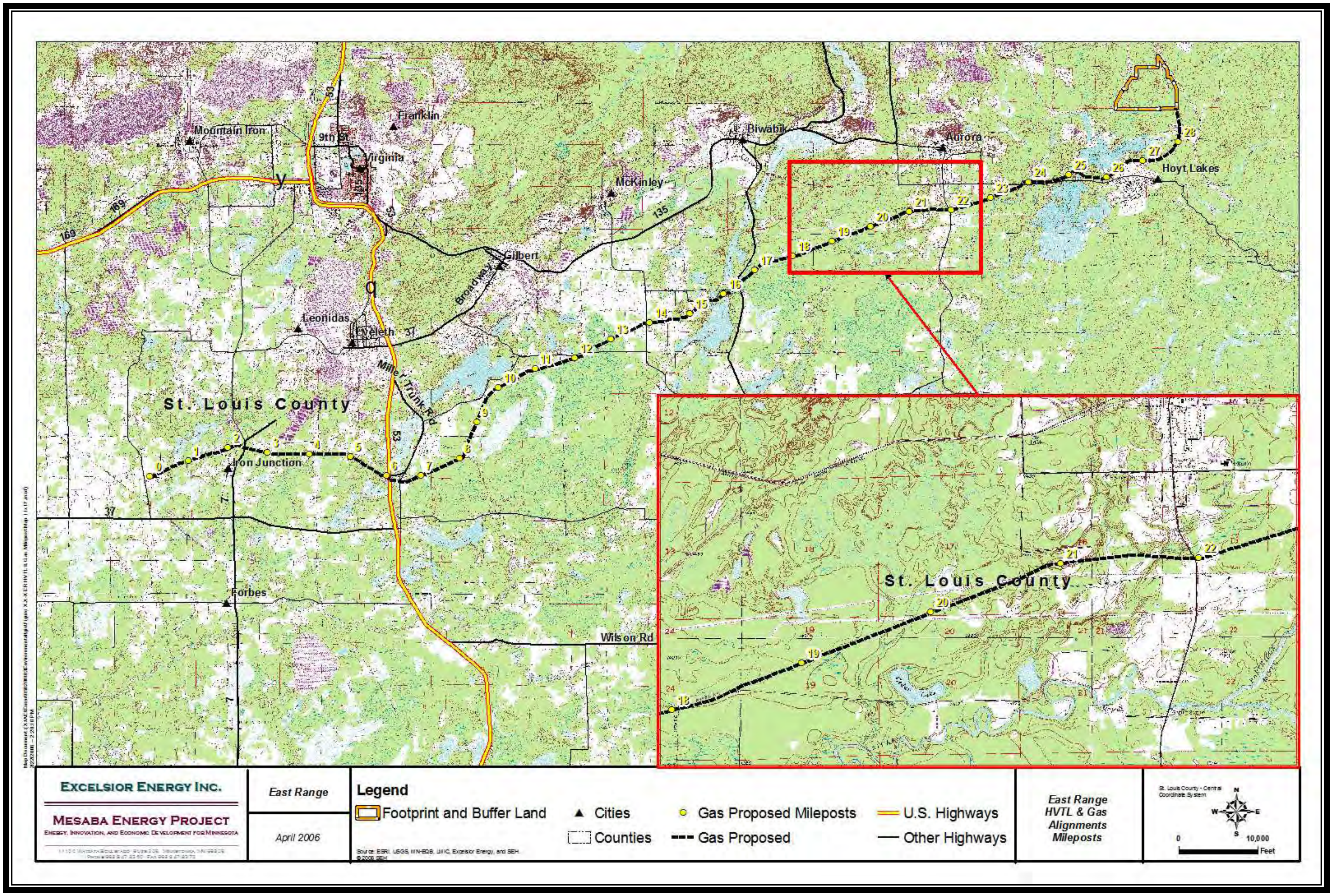


Figure 2.6-21 East Range Proposed Natural Gas Pipeline Route: Segment 1

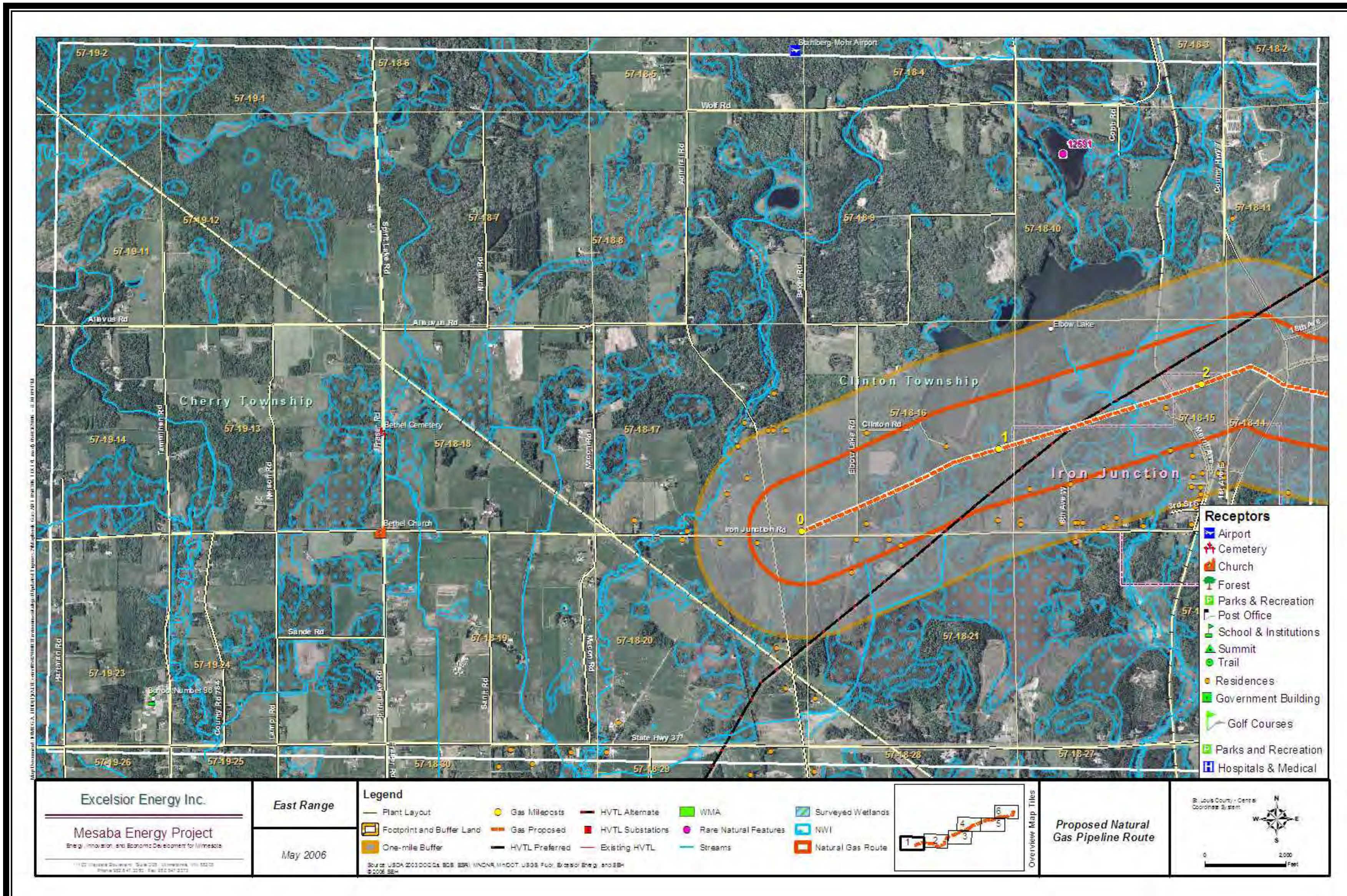


Figure 2.6-22 East Range Proposed Natural Gas Pipeline Route: Segment 2

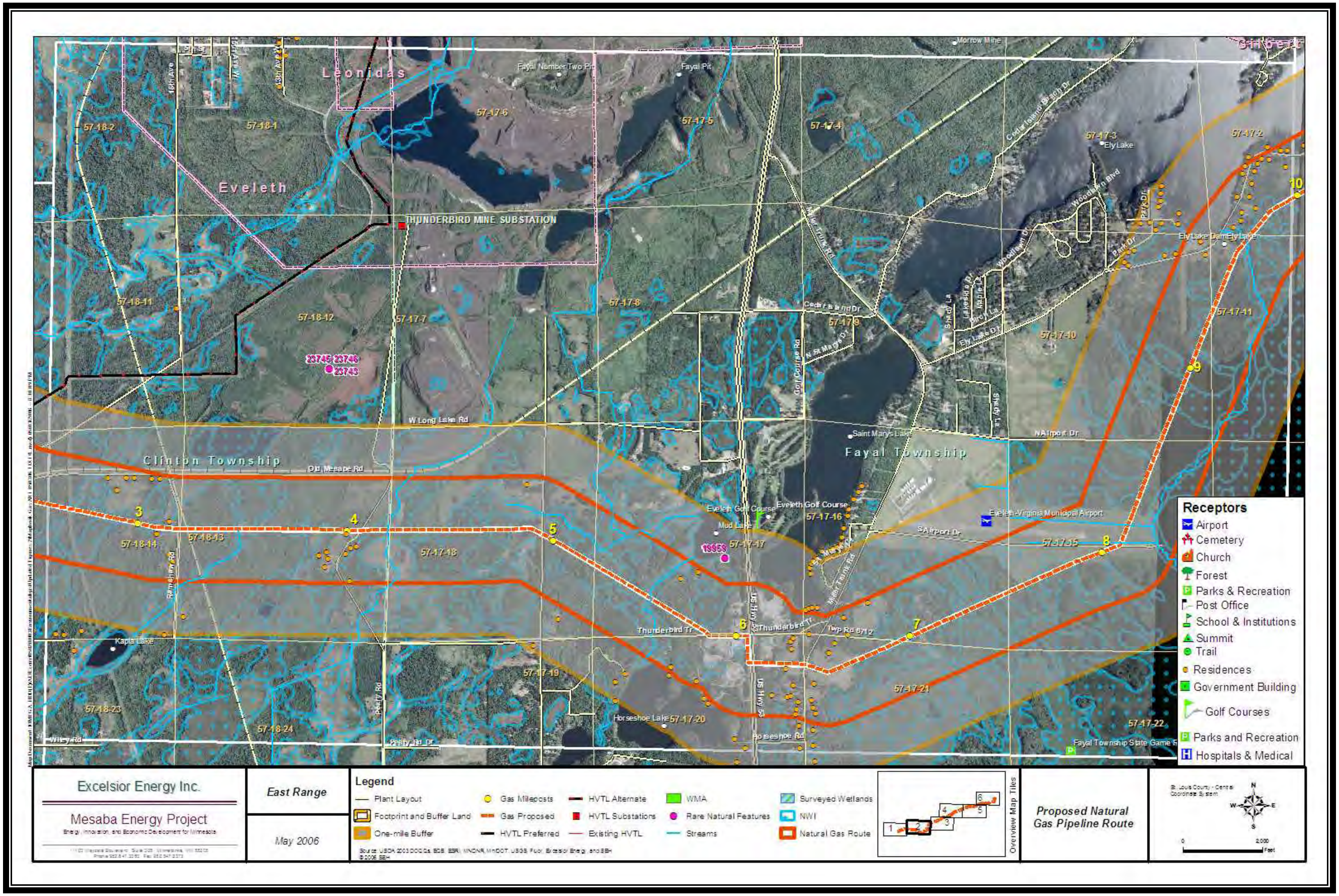


Figure 2.6-23 East Range Proposed Natural Gas Pipeline Route: Segment 3

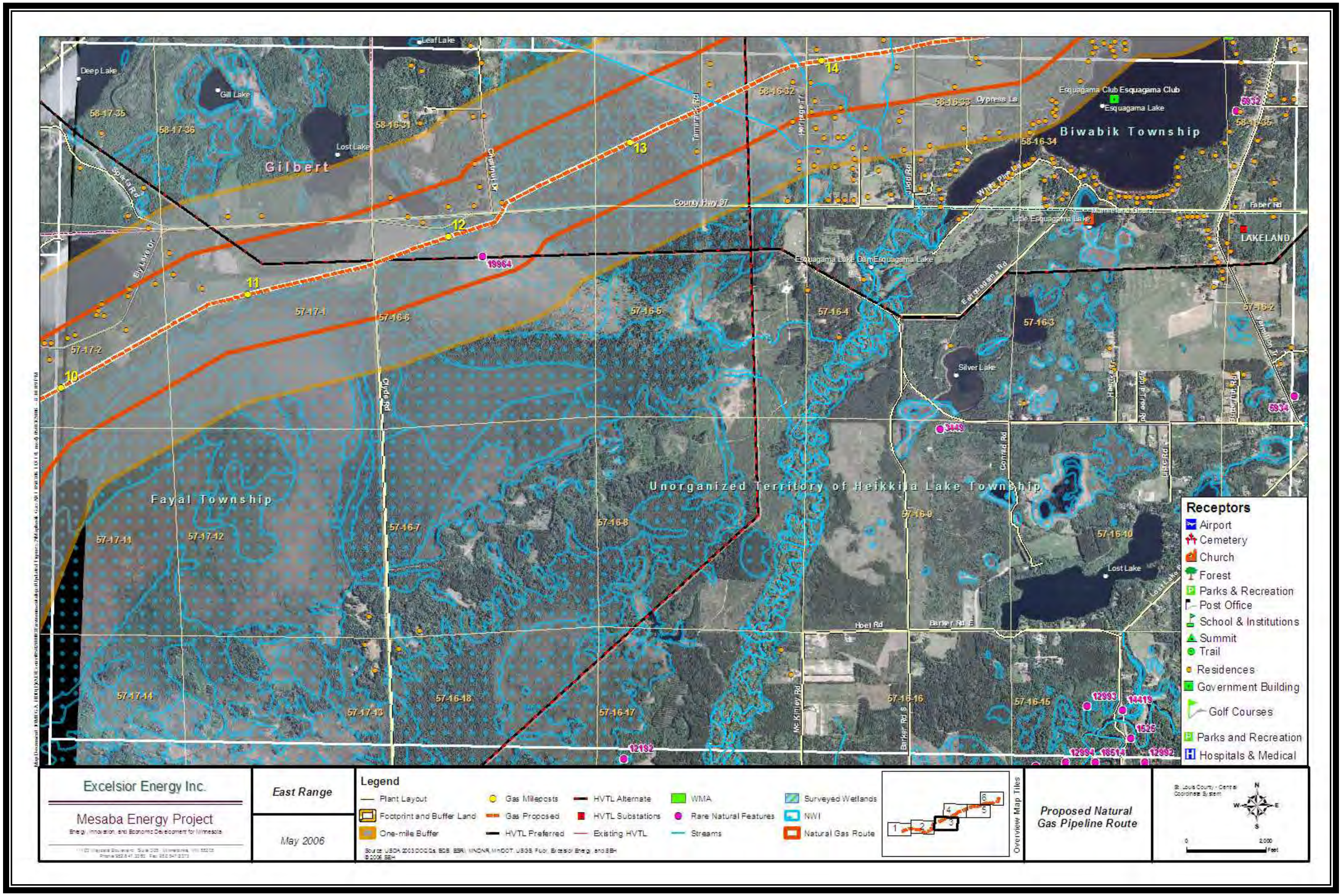


Figure 2.6-24 East Range Proposed Natural Gas Pipeline Route: Segment 4

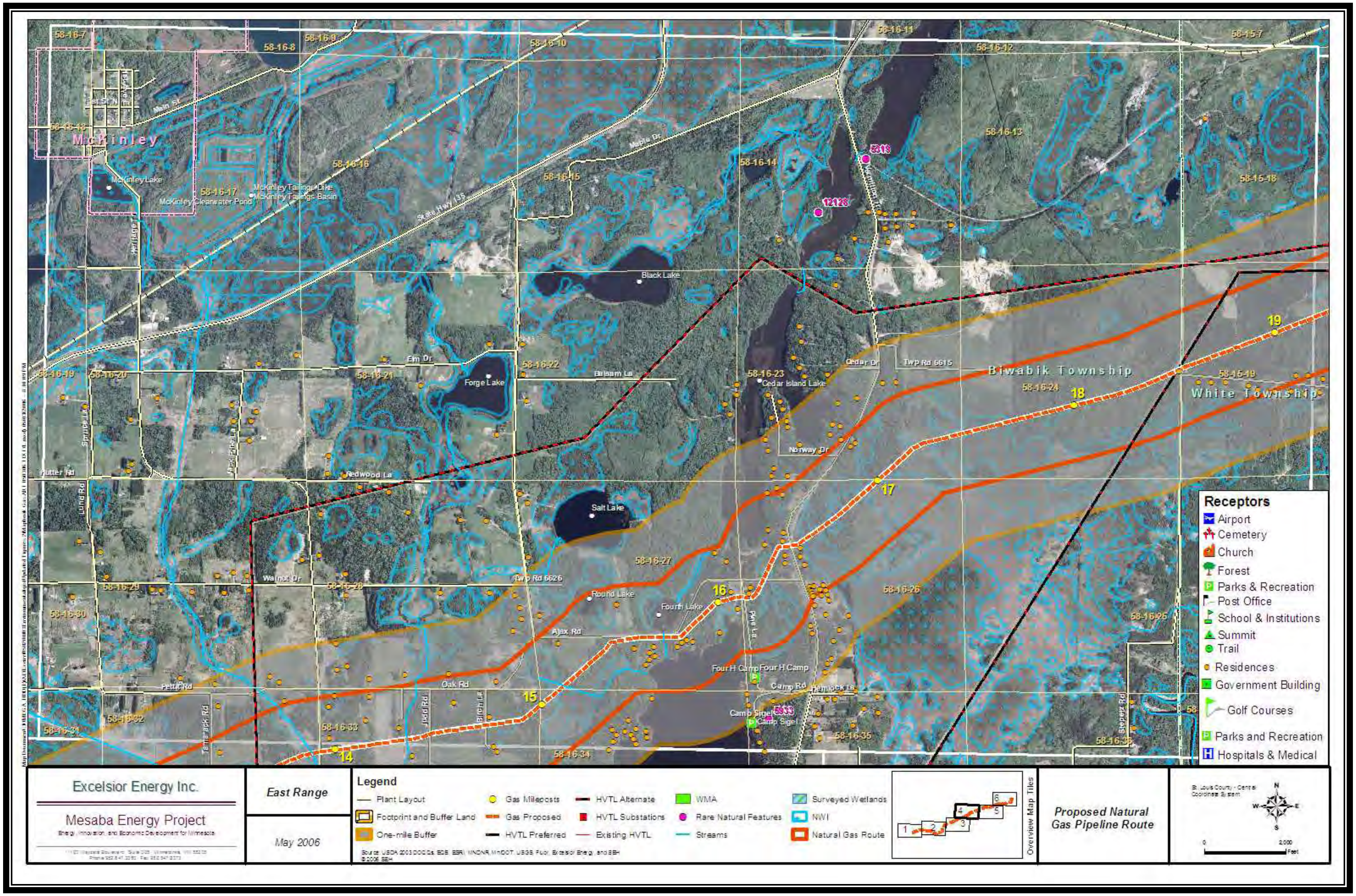


Figure 2.6-25 East Range Proposed Natural Gas Pipeline Route: Segment 5

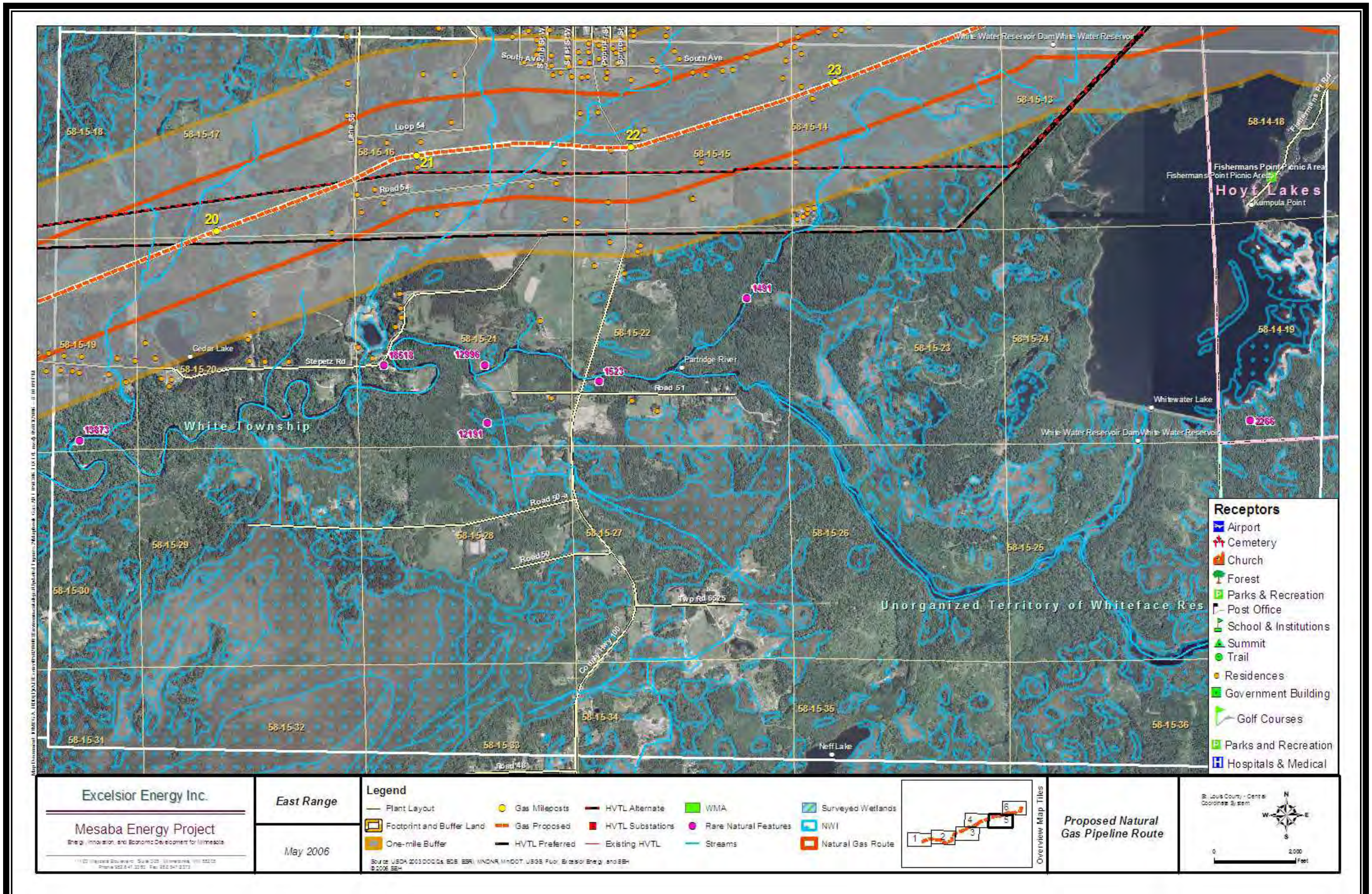
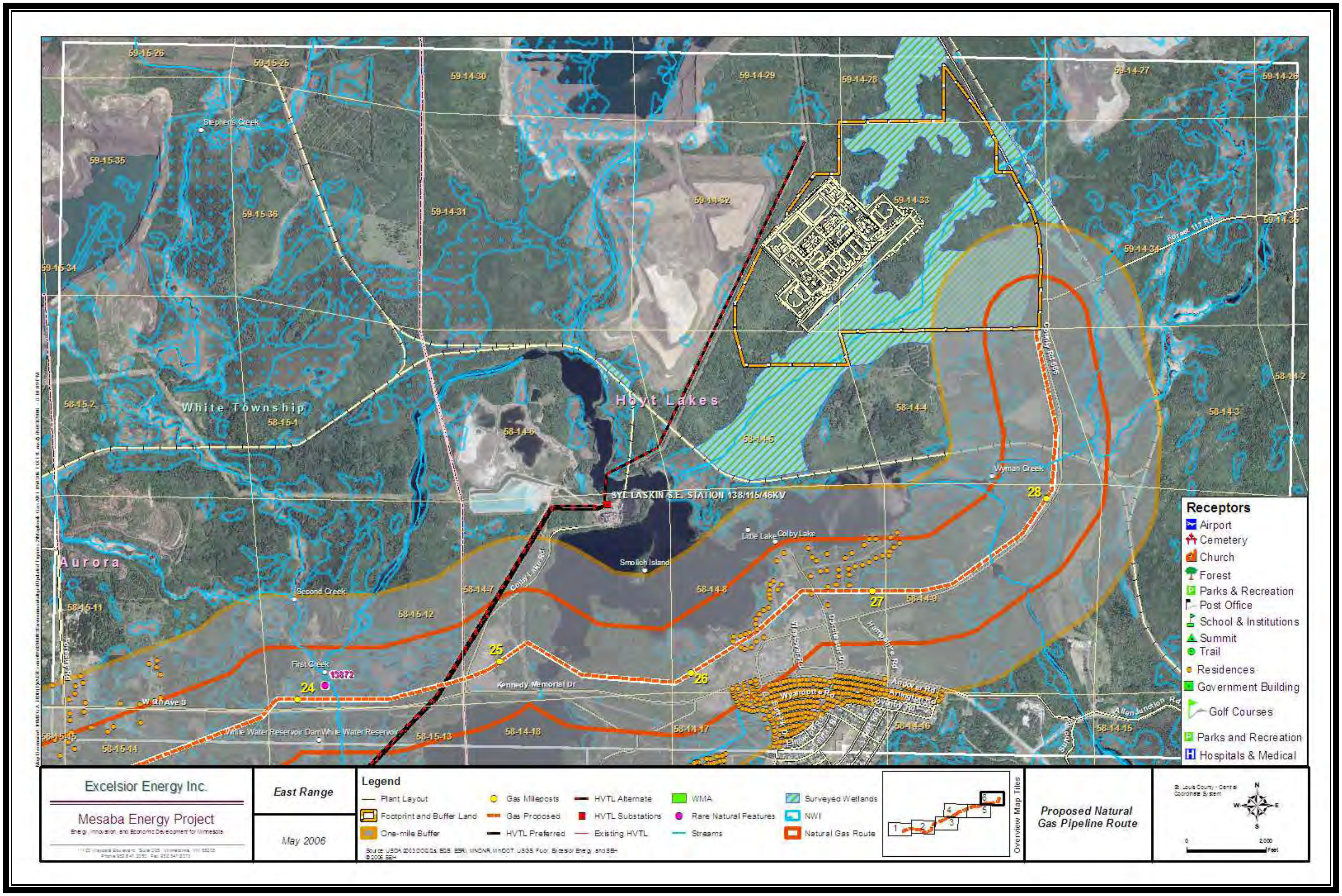


Figure 2.6-26 East Range Proposed Natural Gas Pipeline Route: Segment 6



2.7 SUMMARY COMPARISON OF WEST RANGE AND EAST RANGE SITES

This section compares the West Range and East Range Developments and demonstrates the reasons for the Applicant's preference of the West Range Site. Table 2.7.1 lists key environmental considerations based on the requirements outlined in the PPSA and Minn. R. ch. 4400 and key infrastructure considerations that were evaluated in comparing the preferred and alternate sites. Items marked with a "+" indicate that the physical location under consideration demonstrates environmental characteristics that are decidedly favorable. An "O" indicates that the physical location demonstrates environmental characteristics that are acceptable, but neither decidedly favorable or unfavorable. Neither of the Sites demonstrate environmental characteristics that are decidedly negative.

Table 2.7-1 Comparison of West Range and East Range Sites

Elements of Comparison	West Range	East Range	Comments
Environmental Considerations			
Effects on Human Settlement			
Public health and safety	O	O	
Displacement	O	O	
Noise	O	+	Significant receptors around the East Range IGCC Power Station are further removed than the West Range receptors, reducing potential noise impacts, however, operations at both locations will be conducted in compliance with applicable Minnesota noise standards.
Aesthetics	O	O	East Range IGCC Power Station residents are further removed, but the Station will be more visible to them. West Range will have more passenger car traffic. West Range HTVL is shorter.
Socioeconomic impacts	O	O	
Cultural values	O	O	
Recreation	O	O	
Public services	+	O	The extension of City of Taconite water supply and sanitary sewer systems to serve the West Range Developments will also be able to serve new business or residential development. Power Station will serve as long-term flood control measure.
Effects on Land-based Economies			
Agriculture	O	O	
Forestry	O	O	
Tourism	+	O	West Range Station operating plans support Hill-Annex State Park Plans as a result of lowering water levels in the Hill-Annex Mine Pit.
Mining	O	O	Both West and East Range Phase I and Phase II Developments could provide potential synergies with new industrial entities.

Elements of Comparison	West Range	East Range	Comments
Effects on Archaeological and Historic Resources	+	O	The lowering of water levels in the Hill-Annex Mine Pit will benefit the Hill-Annex State Park by exposing historic mining features
Effects on the Natural Environment			
Air quality	+	O	Developments at both Stations will have very low pollution emissions, however, the East Range IGCC Power Station is less desirable given its closer proximity to the BWCA.
Water quality	O	+	The East Range IGCC Power Station will not discharge any process or cooling water because of ZLD system. The West Range IGCC Power Station discharges will be limited to non-contact cooling water; the pollutant mass discharged will be no greater than that currently permitted.
Solid waste	+	O	The East Range IGCC Power Station will generate up to 24,000 tons of salts per year from the evaporation of process water and cooling tower blowdown in the ZLD systems. The salts produced by the combined ZLD systems must be landfilled. Both Stations will produce marketable by-products.
Flora and fauna	O	O	
Effects on rare and unique natural resources	O	O	
Use of Existing Right-of-Way	O	O	The East Range HVTLs and natural gas pipeline will parallel existing ROWs over much of the length of new lines, however, 30 feet of new ROW will be required along the HVTL route. Approximately 30% of West Range Preferred HVTL Route will use existing ROWs. Use of existing natural gas pipeline rights-of-way on West Range will depend on whether Proposed Route or NNG options are selected.
Infrastructure Considerations			
Site	+	+	The footprint for both the West and East Range IGCC Power Stations are in areas reserved for the support of industrial development.
Electric Transmission	+	O	Shorter new HVTL is needed to connect the West Range IGCC Power Station with its POI.
Gas Supply	+	O	The West Range IGCC Power Station has three viable options supplying natural gas, the East Range has a single source available.
Water Supply/Wastewater	+	O	The West Range location has the need to draw from fewer water sources and will address the existing need for long-term flood control. The East Range Station will not discharge any wastewaters.

Elements of Comparison	West Range	East Range	Comments
Rail/Truck Transportation	+	O	Two railroad companies can immediately serve the West Range IGCC Power Station, providing competition for transportation of fuels, while the East Range Station can be initially served by only one railroad company.
Energy Efficiency	+	O	The efficiency of the East Range IGCC Power Station is reduced compared to the West Range Station due to the additional load from the cooling water ZLD system and higher transmission line losses.
Cost	+	O	The total capital cost of the Project is greater on the East Range Site compared to the West Range Site. *See* Section 2.8.

Minnesota Rule 4400.1150, subparts 3G. and 3H. require an applicant to identify human and natural environmental effects that cannot be avoided if the facility is approved at a specific site, describe measures that might be implemented to mitigate those potential human and environmental impacts, and estimate the costs of such mitigative measures. Potential effects on the human and natural environment from the IGCC Power Station and planned design and operational mitigative measures are described throughout this Application and more specifically in Section 7 (West Range Developments) and Section 8 (East Range Developments). Table 2.7-2 summarizes the most significant unavoidable effects and proposed mitigative measures associated with the IGCC Power Station at each of the proposed sites.

Table 2.7-2 Summary of Unavoidable Effects and Mitigative Measures

Unavoidable Human and Natural Environmental Effects	Mitigative Measures	Estimated Incremental Cost of Mitigative Measures
Common to Both Sites		
1. Taking/disturbance of Land	• Minimize disturbed areas through compact footprint design • Utilized common utility and transportation corridors • Parallel existing utility and transportation corridors	No incremental cost
2. Air emissions	• Minimized through use of IGCC technology and air pollution control equipment; provide basis for reducing importation of air pollutants from out of state	Inherently low polluting technology that is expected to be low cost over its life cycle
3. Aesthetic impacts of stacks and transmission towers	• Maintenance of tree buffers between IGCC Power Station and visual receptors • Parallel existing transmission lines	No incremental cost

Unavoidable Human and Natural Environmental Effects	Mitigative Measures	Estimated Incremental Cost of Mitigative Measures
4. Filling of wetlands	• Siting and routing to avoid and minimize to the extent feasible. Replace in accordance with permit conditions • Construction techniques designed to minimize impacts	See Section 2.8
5. Noise generation	• Comply with applicable noise level standards through employment of noise-dampening generating plant equipment	See Section 2.8 -
6. Increased train traffic	• Provide grade separation at intersections potentially affected by unloading activities	See Section 2.8
7. Increased vehicular traffic	• Upgrade existing roadways and intersections	CR 7 reroute and intersection with US 169 improvement is proposed by Itasca County
Unique to West Range Site		
1. Lowering of mine pit water levels	• Positive effect—benefits interpretation of features in Hill-Annex State Park, maintains Canisteo Mine Pit below flood levels	No incremental cost
2. Discharge of Water	• Reduce water discharges through recycling of cooling water	No incremental cost
	• Reduce water discharges through employment of ZLD system for gasification process	See Section 2.8
	• Use of water from HAMP currently being discharged to Upper Panasa Lake, which discharges to Lower Panasa Lake, and ultimately to the Swan River	No incremental cost
Unique to East Range Site		
1. Discharge of Water	• No discharge of water through employment of ZLD system for gasification process and ZLD for cooling system	See Section 2.8

Table 2.7-3 below provides a quantitative comparison between the Ease Range and West Range Sites.

Table 2.7-3 Quantitative Comparison of Land Use-Related Attributes at West Range (Preferred) and East Range Sites

Site	Mesaba One and Mesaba Two Permanent Land Use Impact (Acres)				Total Route Length Preferred Routes (miles)[1]					New or Widened Right-of-way (miles)[2]					Total Permanent Impacts By Corridor (acres)[3]					Total Permanent Impacts By Land Use (Acres)	
	Forest	Wetland	Cultivated Farmland	Other	Transmisison[4]	Natural Gas Pipeline[5]	Water Pipelines[6]	Roads[7]	Rail	Transmission [4]	Natural Gas Pipeline[5]	Water Pipelines[6]	Roads[7]	Rail	Transmisison[4]	Natural Gas Pipeline[5]	Water Pipelines[6]	Roads[7]	Rail	Wetlands[8]	Forest
West Range Site	150	31	0	5	8.7	13.2	18.6	5.0	6.0	6.2	12.3	9.4	5.0	3.0	134	112	112	45	67	172	456
East Range Site	142	16	0	9	68.3	28.8	10.0	1.9	3.4	35.1	0.0	7.9	1.9	1.3	132	0	51	28	40	133	294

Notes

1 The total route length counts every individual unit (i.e., HVTL structure, pipeline, road and/or rail track) within a defined corridor type For example, if two separate process water supply pipelines one mile in length occupy the same corridor, the total route length would be equal to two miles; if one HVTL double circuit structure carrying two lines traversed a corridor three miles in length, the total route length would be three miles; if two HVTL structures each carrying a single circuit traverse a shared corridor for two miles, the total route length would equal four miles.

2 The total new or widened ROW miles presented does not double count segments of a route occupied by more than one HVTL structure, pipeline or transportation element.

3 Total permanent impacts include land use changes involving terrestrial, aquatic, and/or wetland impacts. Land use changes that involve conversion of gravel pits or mines to a particular corridor type are not counted in this table.

4 West Range Preferred HVTL Route is a double-circuit 345-kV on single route; East Range HVTL Route uses two 345-kV circuits on separate routes (both double circuits with existing 115-kV lines). East Range HVTLs use existing 115-kV ROW (except 4-miles), but one HVTL must use 30' of widened ROW.

5 Natural gas pipeline for East Range falls under FERC jurisdiction, so does not require PPSA HVTL Route Permit.

6 Water pipelines include process water supply, process water blowdown, potable water, and domestic wastewater pipelines.

7 West Range roads include Access Road 1 and Access Road 2. Access Road 1 is 3.4 miles in length and would be constructed by Itasca County for purposes of lessening traffic hazards associated with heavy construction traffic (related to Mesaba One, Mesaba Two, and Minnesota Steel Industries' steel mill).

8 The wetland impacts noted reflect loss of the entire wetland habitat within the rail loop at both sites. The Applicant will strive to eliminate such permanent impacts, however, for purposes of conservatism, the impacts noted above do not reflect such plans.

Table 2.7-4 Quantitative Comparison of Environmental-Related Attributes at West and East Range Sites

	Mesaba One and Mesaba Two Air Emissions[1] (Tons Per Year; Hg in lbs/yr)				lbs/MWh (gross)	Class I Visibility (Days >10% Impact BWCA)[4]	Protected Waters Crossed Preferred HVTL	Protected Waters Crossed Proposed Natural Gas Pipeline	Protected Waters Crossed Water Pipelines	Average Water Appropriation (GPM)[5]	Cooling Tower Blowdown Discharge (GPM)[6]	ZLD Filter Cake Solid Waste (TPY)[7]
	SOx	NOx	PM_{10}	Hg[1]	CO_2[3]							
West Range	1390	2872	493	54	2016(SB) 1831(B)	15	1	2	2	4400(I) 10300(II)	890(I) 3500(II)	~4400(GI)
East Range	1390	2872	709	54	>2016(SB) >1831(B)	69	20	12	5	7,400	0	~4400(GI) <24500(PI)

1 Figures provided represent stack and fugitive emissions of criteria pollutants assuming 100% capacity factor (sulfur dioxide, nitrogen oxides, volatile organic compounds, and particulate matter are included in totals). See Application for Part 70/New Source Review Construction Authorization attached as Appendix 5 for basis of estimate.

2 Mercury emissions from stack emission points represent peak annual emissions accepted as permit limit.

3 SB= Subbituminous Coal; B= Bituminous Coal; East Range Site with ZLD will have lower efficiency and higher emissions per MWh.

4 Visibility based on Calpuff Method 2, 1992 Met.Data.

5 I = Phase I; II= Phase I + II.

6 I = Phase I; II= Phase I + II; East Range ZLD eliminates discharge of cooling tower blowdown.

7 Fuel dependent; GI = Gasification Island; PB = Power Block (i.e., eliminating cooling tower blowdown).

Table 2.7-5 Quantitative Comparison of Environmental-Related Attributes at West and East Range Sites

Site	Number of Nearby Residences Within Distance of Preferred Options								Closest resident to IGCC Power Station Footprint (Miles)	Closest Resident to Rail (Feet)
	One Mile of IGCC Power Station Footprint	300' HVTL Centerline Alignment	1300' HVTL Centerline Alignment	1300' Gas Pipeline Centerline Alignment	300' Rail Centerline Alignment	1300' Rail Centerline Alignment	300' Roads Centerline Alignment	1300' Roads Centerline Alignment		
West Range Site	~46	1	17	78	0	10	1	10	0.6	400-500
East Range Site	1	27	479	46	0	0	0	0	1.0	4400

2.8 PREFERRED AND ALTERNATE SITE COMPARISON OF CONSTRUCTION AND OPERATING COST

As part of the comparison of the Preferred and Alternate Sites, the Applicant evaluated the cost differences of developing each Site and operating each IGCC Power Station and its associated facilities. The capital cost differences shown in Table 2.8-1 represent such costs. Cost elements evaluated included site preparation (site clearing and grading), wetland impacts, and infrastructure such as rail spur, access roads, process water supply and discharge, domestic water supply and wastewater discharges, and generator outlet interconnections.

The ongoing operational costs and site development capital cost differences are presented in Table 2.8-2 as the net present value (NPV) of the difference in annual operating and captial costs for a 25-year period. The operational cost elements included feedstock transportation costs, energy delivered to the POI, emissions allowances and waste disposal costs. The NPV of the increased operational costs associated with the East Range IGCC Power Station is approximately $205 Million. Additional coal and natural gas transportation costs and lost revenues are the main drivers in the additional operating cost for the Alternate Site.

Table 2.8-1
Site Development Capital Cost Comparisons for
Mesaba One and Mesaba Two (2005 $)

Development Element	Preferred Site (West Range)	Alternate Site (East Range)	Cost Difference Driver
Site Preparation	Base Case Plus $10.1 Million	Base Case	Less fill for Alternate Site
Rail	Base Case Plus $5.5 Million	Base Case	Less distance and less cut on Alternate Site
Site Access	Base Case Plus $12.2 Million	Base Case	Less cut and fill on Alternate Site
Process Water Supply	Base Case Plus $2.1 Million	Base Case	
Process Water Disposal	Base Case	Base Case Plus $11.9 Million	Zero liquid discharge system on Alternate Site
Potable Water and Domestic Wastewater Treatment	Base Case Plus $1.2 Million	Base Case	Longer distance to and from Municipal source
GO HVLT	Base Case	Base Case $59.2 Million	Additional Generator Outlet Transmission Interconnection Costs for Alternate Site
Natural Gas Pipeline	Base Case	Base Case $22.9 Million	Longer pipeline and compressor station upgrades
Noise	Base Case $15 Million	Base Case	Additional noise attenuation enhancements

Table 2.8-2
Operations and Maintenance Cost Differential (2005 $)

	Preferred Site (West Range)	Alternate Site (East Range)	Cost Difference Driver
Net Present Value of Operational and Capital cost differences	BASE	$260 Million	Additional costs related to delivery of primary feedstocks to the site, disposal of ZLD solids, higher losses over HVTLs, and increased auxiliary power use on Alternate Site as well as additional capital costs associated with longer generator outlet HVTLs and natural gas pipeline facilities, and need to eliminate East Range process water discharge.

3. GENERATING PLANT ENGINEERING AND OPERATIONAL DESIGN

3.1 PROCESS DESCRIPTION

This section describes the IGCC Power Station (an LEPGP) and its Associated Facilities. The HVTL GO outlet facilities and the natural gas pipeline facilities are described in Section 4 and Section 5, respectively.

3.1.1 Technology Selection

ConocoPhillips was selected as the gasification technology licensor for the Project in the spring of 2004. Following its selection announcement, Excelsior began working with ConocoPhillips to explore using different solid fuel feedstocks utilizing ConocoPhillips' E-Gas™ technology. Based upon optimization analyses conducted over a one-year period, Excelsior determined that Mesaba One and Mesaba Two should be designed as "feedstock flexible" facilities capable of utilizing petroleum coke, bituminous coal, sub-bituminous coal, and certain combinations of such feedstocks. Such design will likely minimize long-term energy costs and provide significant life-of-plant benefits to consumers given the IGCC Power Station's capability to utilize different feedstocks and transportation systems.

3.1.2 Process and Equipment Descriptions: Introduction

Detailed descriptions of the gasification/power production processes characteristic of an E-Gas™ Technology-based IGCC Power Station are provided in the remainder of this Section. The descriptions provided address the following elements:

- Underlying basis for all computations included in this Joint Application (Section 3.1.3)
- Process chemistry (Section 3.1.4)
- Process subsystems and their operation (Section 3.1.5)
- IGCC Power Station utility systems (Section 3.1.6)
- Major process equipment (Section 3.1.7)
- Operating characteristics (Section 3.1.8)

The major subsystems of the IGCC Power Station that are discussed in detail below include: oxygen supply; feedstock slurry preparation; gasification; slag handling; syngas cooling; particulate matter removal; syngas scrubbing; low temperature heat recovery; acid gas removal; sulfur recovery; tank vent collection; sour water treatment; and the combined cycle power block.

Overall schematic block flow diagrams ("BFD") identifying important equipment and processes related to air pollutant emissions from the Phase I and II Developments are presented in Figures 3.1-1 and 3.1-2, respectively. The only difference in these two figures is the numbers assigned to the emission/control points (the identification numbers that are used in the BFDs correspond to the numbers used in the Application for a Part 70/New Source Review Construction Authorization attached as Appendix 5 to this Joint Application). The emission/control points identified in the BFDs are essentially independent of the development phase and/or the Site.

3.1.3 Worst Case Operating Conditions Quantified

During the environmental review and permitting process, the Applicant is required to identify "worst case" operating scenarios that would produce the maximum emissions/discharges associated with construction and operation of the IGCC Power Station. Such scenarios are primarily defined by the operating characteristics of Station equipment and the amounts and characteristics of feedstock to be transported, handled and consumed. Maximum quantities of feedstock consumed and feedstock characteristics are further discussed in Section 3.1.8 and Sections 3.3.1 through 3.3.3 below.

For development of its "worst case" scenario, the Company focused on identifying operating parameters yielding maximum emissions. In general, these scenarios reflect the highest heat input rates and a cautious approach regarding the design optimizations expected to occur (during the FEED process, the preliminary equipment designs used to estimate environmental releases will be refined and uncertainties that now require conservatively high assumptions to be used will be better understood). In employing such an approach, the Applicant is confident that environmental releases and their associated impacts are conservatively analyzed and presented.

Operating conditions producing maximum emissions/discharges from the IGCC Power Station are identified in Table 3.1-1 and Table 3.1-2 in Section 3.1.8. Table 3.1-1 assumes operation of the gasifiers under partial slurry quench ("PSQ") conditions and considers known seasonal influences and the range of potential feedstocks for which the IGCC Power Station will be designed. Table 3.1-2 assumes the same scenarios as Table 3.1-1, but with the gasifier operating in full slurry quench ("FSQ") mode. FSQ is achieved by increasing the coal slurry feed to the second stage of the gasifer to the point where only slurry is used to quench the syngas, thereby eliminating the thermal loss associated with water used to cool the syngas and increasing the overall efficiency of the plant. These efficiency gains will translate into reduced fuel use and, consequently, reduced pollutant emissions/discharges. However, FSQ is an IGCC Power Station design improvement that is subject to further engineering and verification by experience at Wabash River. Therefore, FSQ's expected benefits for the maximum emissions cases are shown in Table 3.1-2, but are not reflected in either the maximum resource requirements or maximum pollutant emissions/discharges quantified in this Application and the ES.

Figure 3.1-1 Phase I IGCC Power Station Emission Source Block Flow Diagram

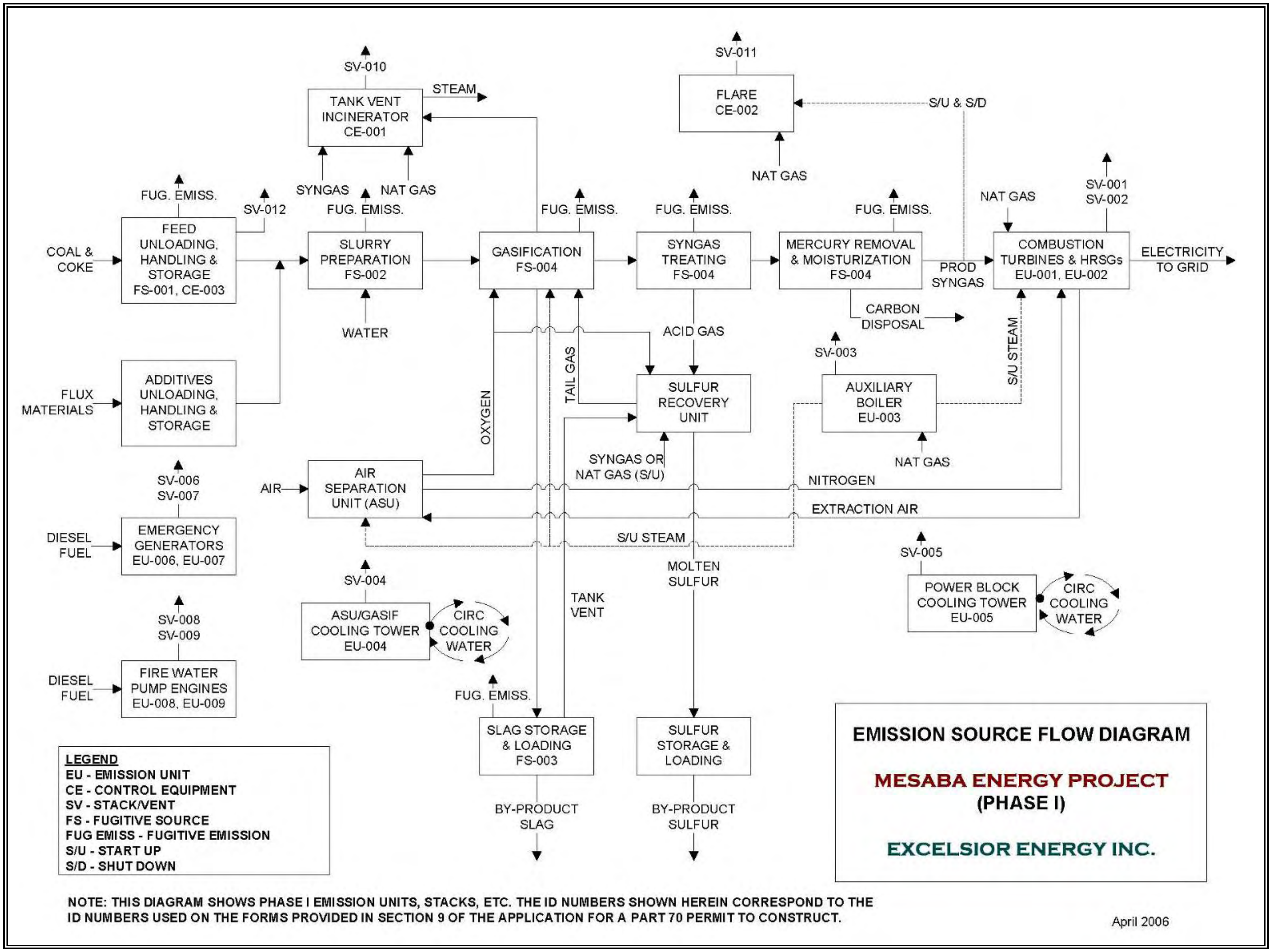
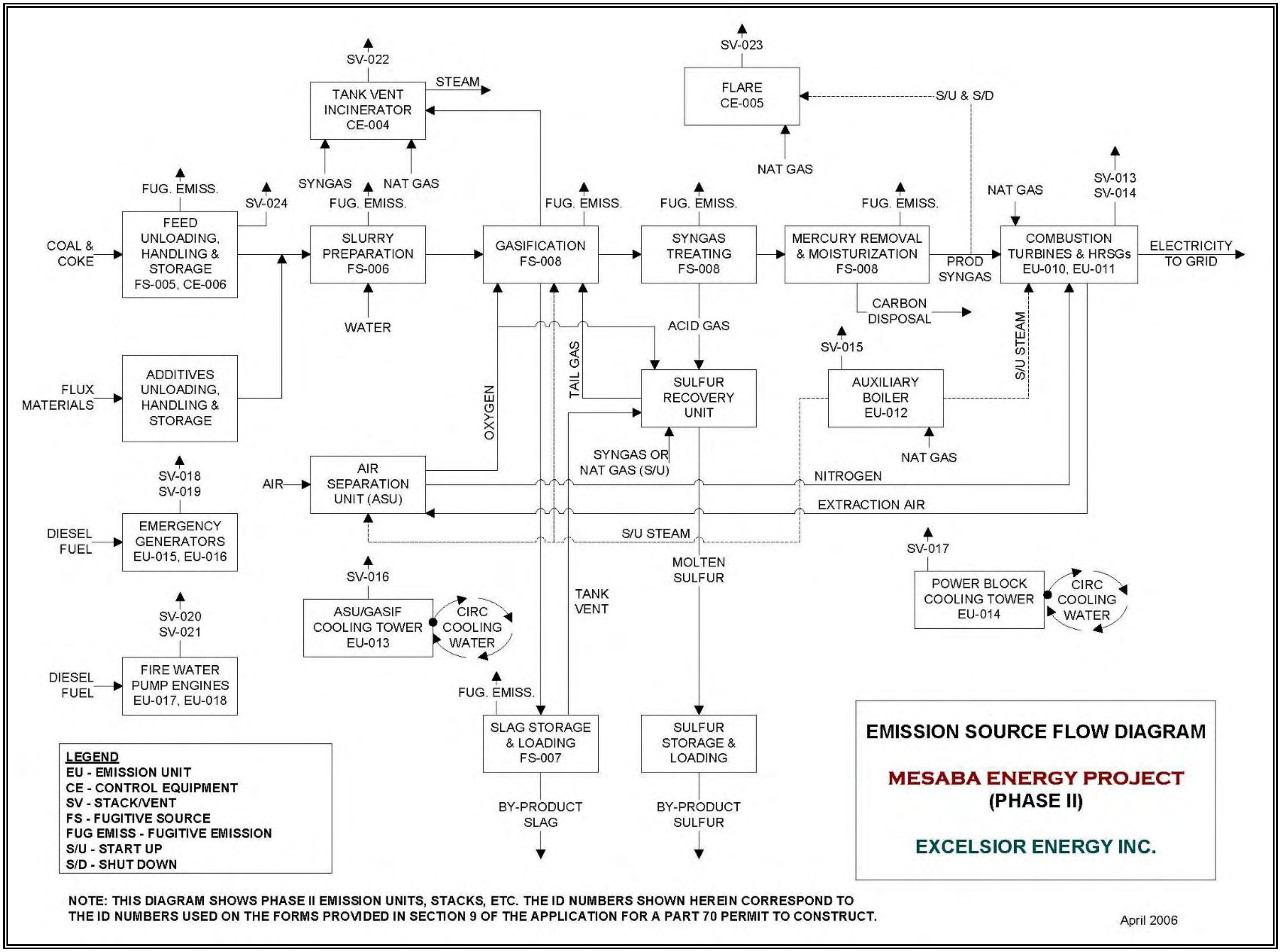


Figure 3.1-2 Phase II IGCC Power Station Emission Source Block Flow Diagram



3.1.4 Process Chemistry

3.1.4.1 Gasification

Coal and petroleum coke are typically characterized by their heating value, elemental analysis (weight percent carbon, hydrogen, nitrogen and sulfur), mineral matter (also known as ash), and moisture content. Unlike traditional pulverized coal power plants where fuel is actually combusted, in an IGCC power station coal slurry is fed to the gasifier along with oxygen (“O_2”) and a number of complex chemical reactions occur. A portion of the feedstock is partially oxidized to provide the temperatures necessary for gasification. The gasification temperature is high enough to break essentially all the chemical bonds present in the coal and establish a new mix of smaller molecules based on the following primary reactions:

$C + O_2 = CO_2$ (rapid exothermic, or heat releasing, oxidation reaction)

$C + ½ O_2 = CO$ (rapid exothermic oxidation reaction)

$C + H_2O = CO + H_2$ (slower endothermic, or heat consuming, reaction)

$C + CO_2 = 2CO$ (slower endothermic reaction)

$CO + H_2O = H_2 + CO_2$ (“water gas shift reaction,” exothermic and rapid)

$CO + 3H_2 = CH_4 + H_2O$ (“methanation reaction,” exothermic)

$C + 2H_2 = CH_4$ (direct methanation, exothermic)

Most of the sulfur in the feedstock is converted to hydrogen sulfide (“H_2S”) during gasification. A small portion of the sulfur is converted into carbonyl sulfide (“COS”). Most of the nitrogen in the feedstock is converted to ammonia (“NH_3”). The syngas composition leaving the gasifier is determined by the gasifier operating temperature and the relative kinetics of the above reactions. Most of the energy in the feedstock is ultimately converted into carbon monoxide (“CO”), hydrogen (“H_2”), and a small amount of methane (“CH_4”). Low grade coals with lower heating values and higher moisture contents will generate a syngas with more carbon dioxide (“CO_2”) and H_2, the additional CO_2 generated from the water gas shift reaction as shown above. Higher quality coals and petroleum coke will result in a syngas that has a much higher CO content.

3.1.4.2 COS Hydrolysis

Because the small fraction of COS formed in the gasifier is difficult to remove in the acid gas removal (AGR) system, the COS is “hydrolyzed” in a catalytic reactor before the syngas is sent to the AGR system. The hydrolysis reaction is shown below:

$COS + H_2O = H_2S + CO_2$

The conversion of COS to H_2S is not 100%, and is limited by the equilibrium conditions at the COS reactor operating temperature.

3.1.4.3 Acid Gas Removal

The acid gas removal (“AGR”) system uses methyl diethanolamine (“MDEA”), a weak base, to remove the H_2S from the syngas. H_2S is an acid that forms weak chemical bonds with the cold lean MDEA solution. Once the MDEA solution absorbs the H_2S, it is called a "rich" solution. The rich MDEA solution is regenerated to a lean MDEA solution by reducing the pressure, applying heat, and boiling. The H_2S released from the rich MDEA under such conditions is sent to the sulfur recovery unit ("SRU").

3.1.4.4 Sulfur Removal

The SRU uses standard Claus technology to convert H_2S to elemental sulfur. The Claus reactions are shown below:

$$H_2S + \frac{3}{2} O_2 = SO_2 + H_2O$$

$$SO_2 + 2H_2S = 2S + 2\,H_2O$$

The Claus reactions occur in two steps. In the first step a portion of the H_2S is combusted with O_2. The sulfur dioxide ("SO_2") that is formed is mixed with additional H_2S and passed over catalyst beds. The Claus reactions are exothermic and reaction heat is recovered, generating low pressure steam. The "tail gas" stream leaving the Claus reactors contains nitrogen ("N_2") and other inert gases that entered with the feeds, along with traces of unconverted H_2S. The tail gas is recycled to the gasifier.

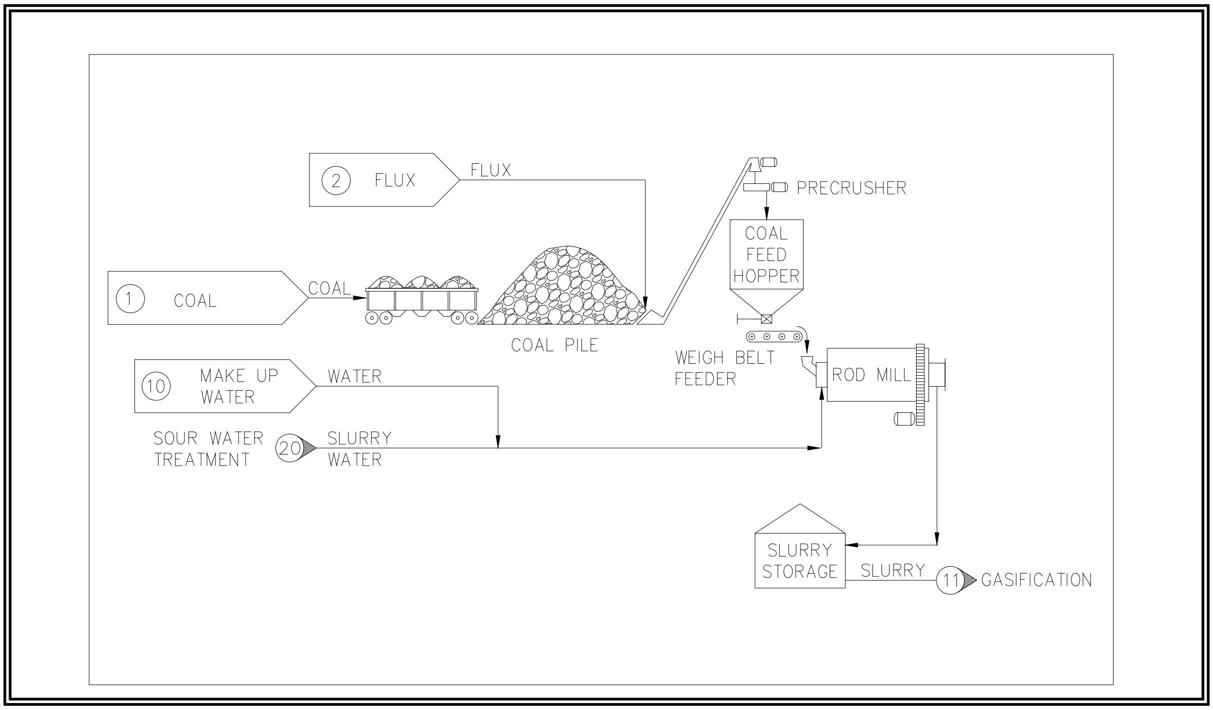
3.1.5 Process Operations

3.1.5.1 Slurry Preparation

To produce slurry gasifier feed, the solid fuel is placed on a weigh belt feeder and directed to the rod mill where it is mixed and ground with treated recycled water and slag fines that are recycled from other areas of the gasification plant. The resulting slurry has a paste-like consistency. The use of a wet rod mill reduces potential fugitive particulate matter emissions from the grinding operations and is an efficient method for producing essentially homogeneous slurry. Collection and reuse of water within the gasification plant minimizes water consumption and wastewater discharge.

Slurry feeding allows for consistent and safe introduction of feed into the gasifiers. Prepared slurry will be stored in an agitated tank. The capacity of the slurry storage tank will be sufficiently large to supply the gasifiers' needs without interruption when the rod mill undergoes normal maintenance requirements. The feedstock grinding and slurry preparation area is depicted in Figure 3.1-3.

Figure 3.1-3 Feedstock Grinding and Slurry Preparation

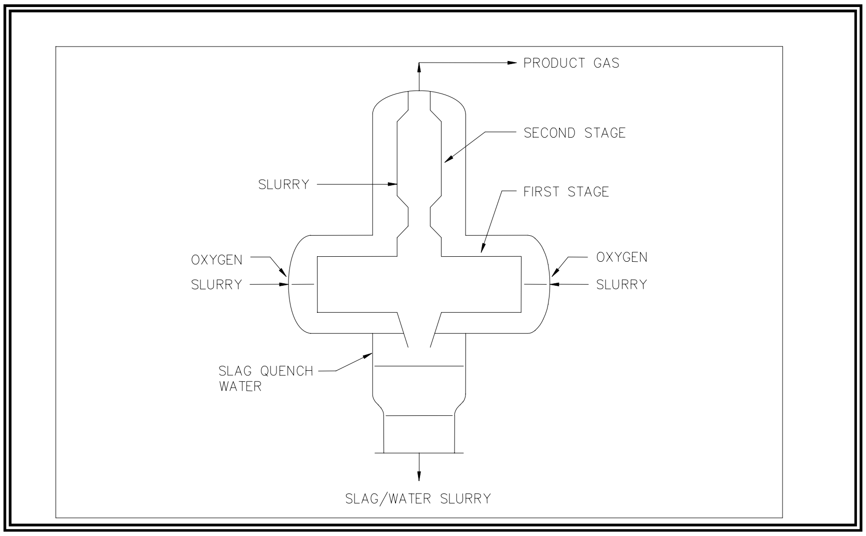


Tanks, drums and other areas of potential atmospheric exposure to the slurry or recycle water will be covered and vented into the tank vent collection system for vapor emission control. The entire feedstock grinding and slurry preparation facility will be paved and curbed to contain spills, leaks, wash down, and storm water runoff. A trench system will carry this water to a sump where it will be pumped into the recycle water storage tank.

3.1.5.2 Gasification and Slag Handling

The E-Gas™ gasifier consists of two stages: a slagging first stage, and an entrained flow, non-slagging second stage, as shown in Figure 3.1-4. The first stage is a horizontal refractory-lined vessel in which feedstocks are exposed to sub-stoichiometric quantities of oxygen at an elevated temperature and pressure. Oxygen and preheated slurry are fed to each of two opposing mixing nozzles, one on each end of the horizontal section of the gasifier. The oxygen feed rate to the nozzles will be carefully controlled to maintain the gasification temperature above the ash fusion point to allow good slag removal and high carbon conversion. The feedstock will be almost totally gasified in this environment to form syngas consisting principally of hydrogen, carbon monoxide, carbon dioxide and water.

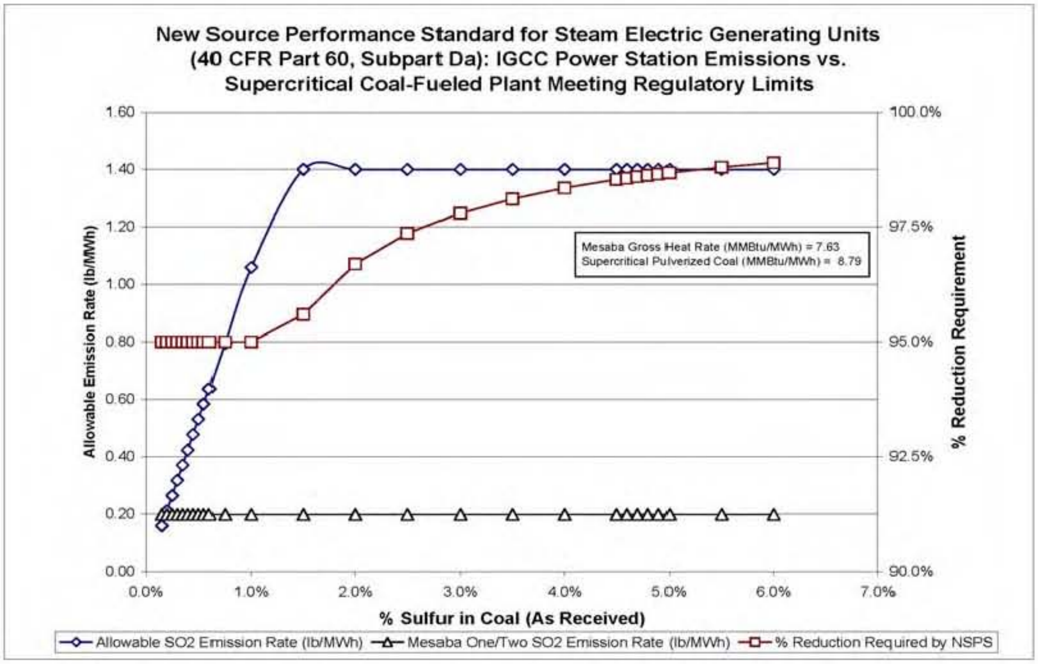
Figure 3.1-4 E-Gas™ Gasifier



Sulfur in the fuel will be converted to primarily H_2S, with a small portion converted to COS. With the processing provided downstream, over 99% of the sulfur will be removed from high sulfur feedstocks and over 97% of the sulfur will be removed from low-sulfur sub-bituminous coal feedstocks. The removal rate from low sulfur coal nonetheless results in approximately equal sulfur emissions rates as the higher removal rate from higher sulfur coal. In other words, the final SO_2 emission rate achieved using E-Gas™ technology is independent of the starting sulfur concentration in the feedstock. Therefore the percentage of SO_2 removed from a higher feedstock that exhibits the same SO_2 emission rate as a lower sulfur feedstock, would show a higher percentage removal rate.

To illustrate, assume a constant emission rate when using either Coal A or Coal B of 0.025 lbs per million Btu heat input (note that this emission rate is far lower than the New Source Performance Standards emission rate imposed by federal law [the emission limit and percentage reduction requirements imposed on SO_2 emissions are illustrated in Figure 3.1-5 along with the SO_2 emissions expected from Mesaba One and Mesaba Two] for a new coal-fueled steam electric generating units).

Figure 3.1-5
New Source Performance Standard vs. Mesaba One/Two SO_2 Emission Rates



The percentage of SO_2 removed for Coal A and Coal B would be as follows:

% SO_2 removal, Coal A (3.0% S, 11,500 Btu/pound higher heating value):

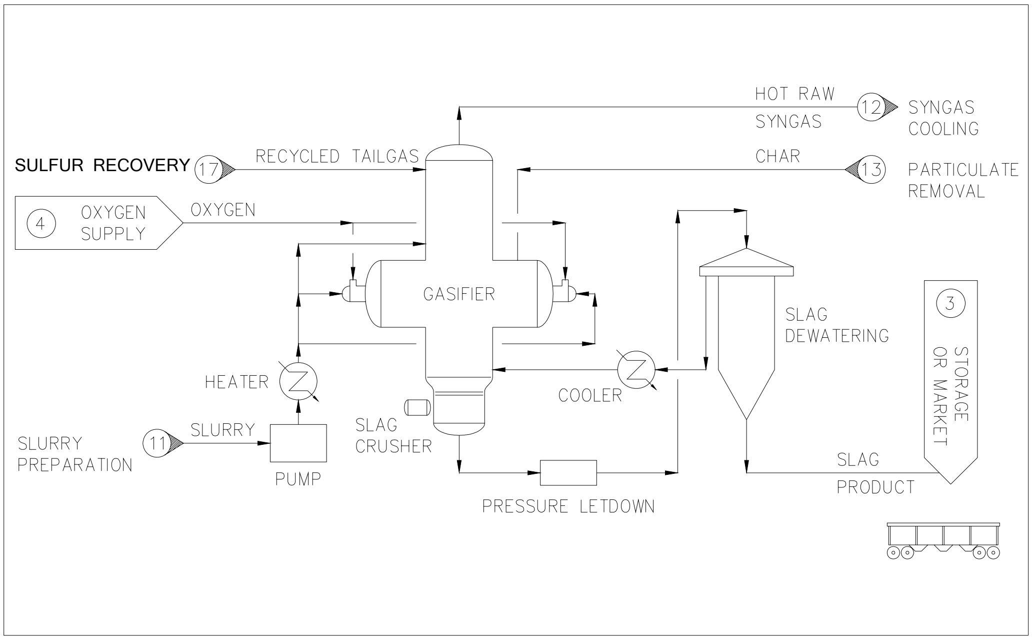
$$\frac{\{[(0.03\text{ lbs S/lb Coal A})*(2\text{ lbs SO2/lb S})*(10^6\text{ Btu/MMBtu})/11{,}500\text{ Btu/lb Coal A}] - 0.025\text{ lb/MMBtu}\}}{[(0.03\text{ lbs S/lb Coal A})*(2\text{ lbs SO2/lb S})*(10^6\text{ Btu/MMBtu})/11{,}500\text{ Btu/lb Coal A}]}\times 100\% = 99.5\%$$

% SO_2 removal, Coal B (0.5% S, 8,300 Btu/pound higher heating value):

$$\frac{\{[(0.005\text{ lbs S/lb Coal B})*(2\text{ lbs SO2/lb S})*(10^6\text{ Btu/MMBtu})/8{,}300\text{ Btu/lb Coal B}] - 0.025\text{ lb/MMBtu}\}}{[(0.005\text{ lbs S/lb Coal B})*(2\text{ lbs SO2/lb S})*(10^6\text{ Btu/MMBtu})/8{,}300\text{ Btu/lb Coal B}]}\times 100\% = 97.9\%$$

Mineral matter in the feedstock and any added flux (see Section 3.3.2 for a description of fluxing agents) forms a molten slag which flows continuously through a tap hole in the floor of the gasifier horizontal section into a water quench bath, located below the first stage. The characteristics of the slag produced in the gasifier will vary with the mineral matter content of the feedstock. As depicted in Figure 3.1-6, the solidified slag exits the bottom of the quench section, is crushed, and flows through a continuous pressure-letdown system as a slag/water slurry. This continuous slag removal technique eliminates high maintenance, problem-prone lockhoppers and prevents the escape of raw syngas to the atmosphere during slag removal. The slag/water slurry is then directed to a dewatering and handling area (described later). The raw syngas generated in the gasifier's first stage flows up from the horizontal section into the second stage of the gasifier.

Figure 3.1-6 Gasification and Slag Handling



Typically, the ash content of coal will be in the range of 5-11%, as received, with ash in petroleum coke expected to average about 0.6%, as received. Slag production at full load will thus vary from about 500 tons per day up to a maximum of about 800 tons per day for each of the two phases of development. The slag will be conveyed from the slag dewatering unit to the slag storage pile using covered conveyors. The storage area will be provided with dust suppression systems. The slag is essentially inert, and will be conveyed from the storage area to rail cars or trucks for transport to market or storage.

The gasifier second stage is a vertical refractory-lined vessel in which additional slurry is reacted with the hot syngas stream exiting the first stage. The feedstock undergoes devolatilization (separation of organic components) and pyrolysis (high temperature decomposition), thereby generating more syngas with higher heat content (less carbon being converted to CO_2) since no additional oxygen is introduced into the second stage. This additional slurry lowers the temperature of the syngas exiting the first stage by the endothermic nature of the devolatilization and pyrolysis reactions. In addition to the above reactions, water reacts with a portion of the carbon to produce additional CO, H_2 (for subsequent use as syngas fuel for power generation), and CO_2. Unreacted solid fuel (char) is carried out of the second stage with the syngas.

Certain other metals present in the feedstocks in trace quantities and volatile at the temperatures typical of the gasifier will also be carried out in their gaseous state as components of the syngas, and removed in the cleanup stage.

The slag/water slurry will flow continuously into the dewatering bin. The bulk of the slag will settle out in the bin while water overflows into a basin in which the remaining slag fines will settle. The clear water from the settler will pass through heat exchangers where it is cooled as the final step before being returned to the gasifier quench section. Dewatered slag is transferred to the slag storage area to be loaded into trucks or rail cars for transport to market or storage. The slurry of fine slag particles from the bottom of the settler will be recycled to the slurry preparation area to be fed back into the gasifier, ensuring maximum carbon utilization.

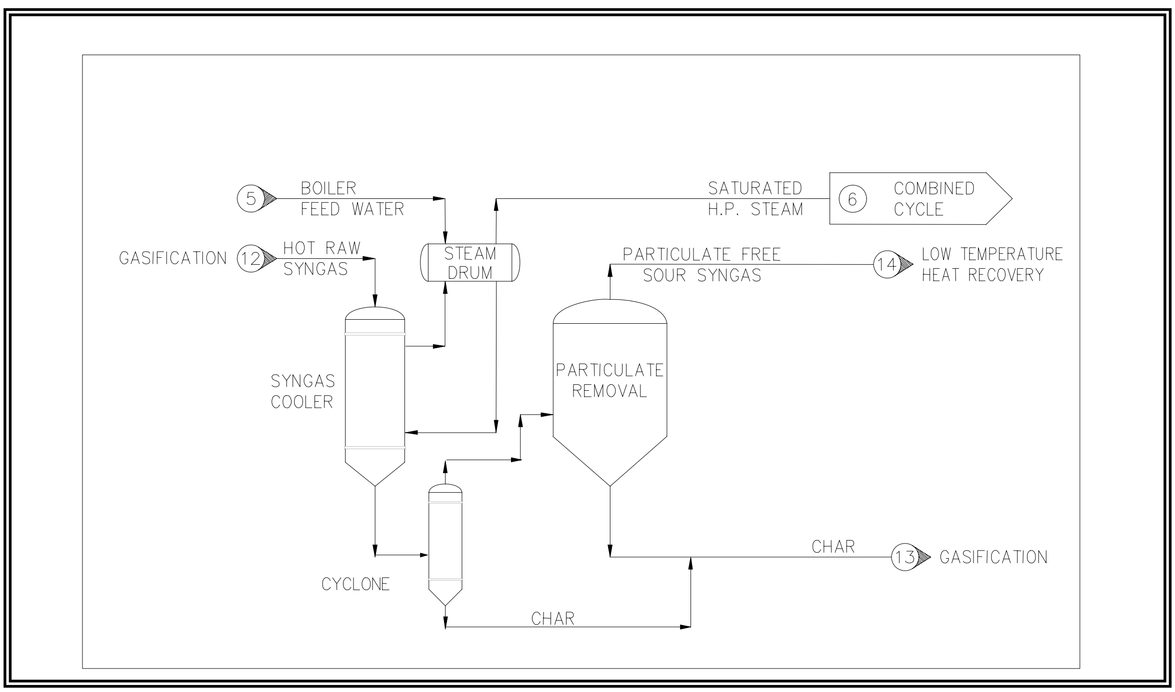
3.1.5.3 Syngas Cleanup and Desulfurization

3.1.5.3.1 Syngas Cooling

As shown in Figure 3.1-7, the next two steps in the process are to cool the syngas and then remove the particulate matter from the syngas stream. Captured particulate matter is recycled back to the gasifier.

The hot raw syngas (with entrained particulate matter) exiting the gasifier system is cooled in the syngas cooler, converting a significant portion of the heat from the gasifier to high pressure steam for use in power generation.

Figure 3.1-7 Particulate Matter Removal



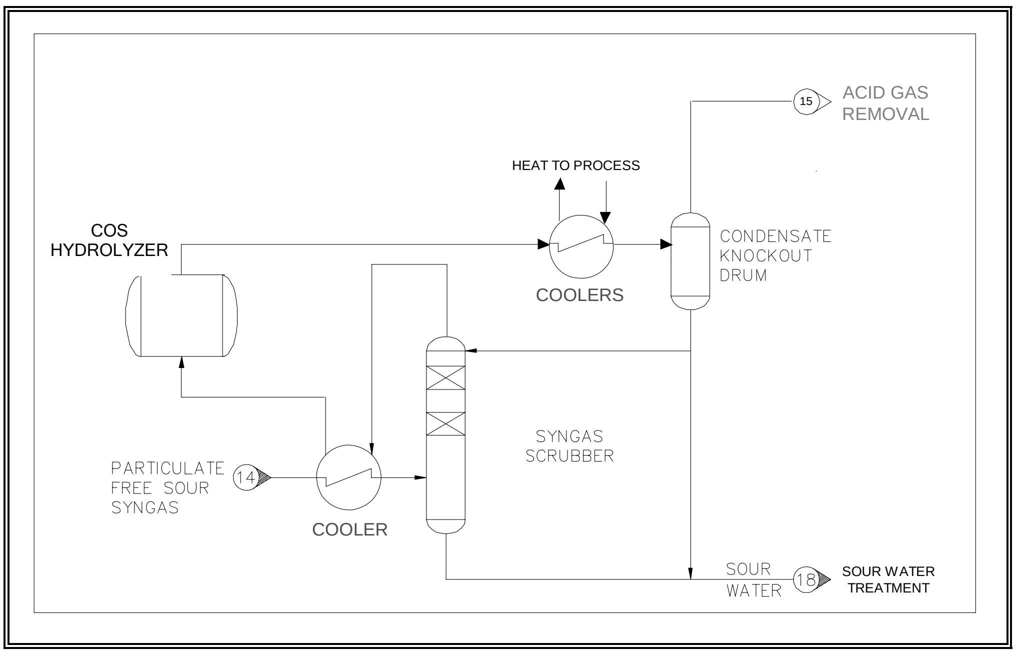
3.1.5.3.2 Particulate Matter Removal

After cooling, the syngas is directed to the particulate matter removal system, as shown in Figure 3.1-6 above. The gas flows first through a hot gas cyclone for removal of relatively large particulate matter and then passes to the particulate matter filter. The filter vessel contains numerous porous filter elements to remove particulate matter. The cleaned syngas exits the unit as a particle free syngas. Particulate matter removal efficiency is expected to be 99.9%. Removed particulate matter from both the hot gas cyclone and the dry filter vessel is recycled to the first stage of the gasifier to improve carbon conversion efficiency. With particulate matter being recycled to the gasifier from both devices, near complete gasification of the carbon content of the feedstock is obtained. The particle free syngas proceeds to the low temperature heat recovery system.

3.1.5.3.3 Syngas Scrubbing, COS Hydrolysis and Low Temperature Heat Recovery

With particulate matter removed from the syngas, additional gas cleanup (including mercury removal) and cooling steps can more easily be performed. The syngas is scrubbed with recycled sour water (water with dissolved sulfur compounds and other contaminants condensed from the syngas) to remove chlorides and trace metals and to reduce the potential of equipment corrosion and formation of undesirable products in the AGR system. This is shown in 3.1-8.

Figure 3.1-8 Syngas Scrubbing

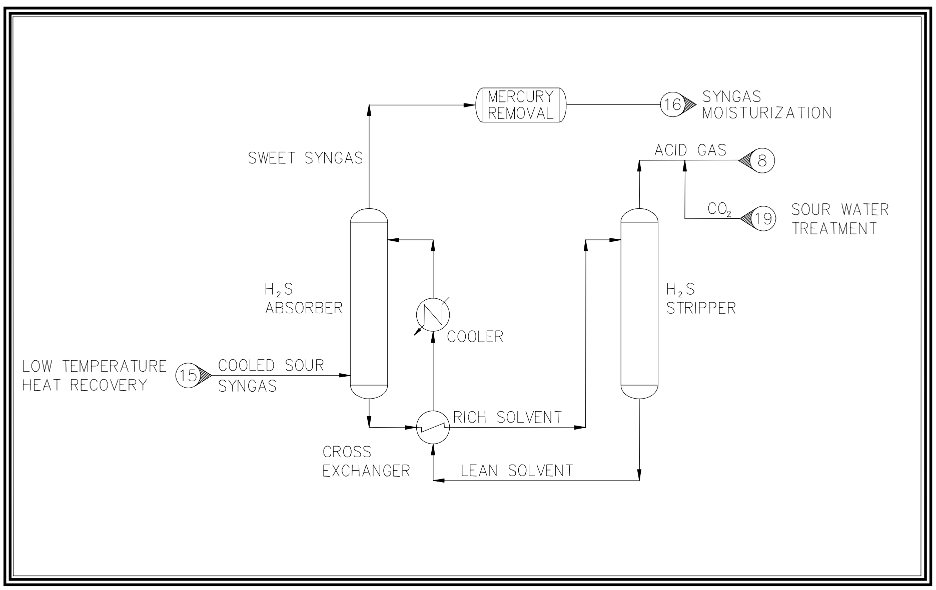


A COS hydrolysis unit is incorporated to achieve a high level of sulfur removal. The purpose of the COS hydrolysis step is to convert the small amount of COS in the syngas to H_2S, which can then be efficiently removed in the AGR system. After hydrolysis, the syngas is cooled in process heat exchangers to efficiently utilize the available but relatively low-temperature heat. Most of the ammonia (NH_3) and a small portion of the CO_2 and H_2S present in the syngas are absorbed in the water condensed by this cooling step. Additionally, some of the trace metals that remained in their gaseous state during the particulate matter removal process will condense. The water is collected and sent to the sour water treatment unit. The cooled sour syngas is fed to the AGR system where sulfur compounds are removed to produce a low sulfur product syngas.

3.1.5.3.4 Acid Gas Removal System

The AGR system (shown in Figure 3.1-9) contacts the cool sour syngas with an aqueous solution of MDEA, an amine absorbent that removes the H_2S to produce a clean product syngas. MDEA chemically bonds with H_2S with a bond that can be easily broken with low level heat in order to regenerate the absorbent. H_2S is absorbed from the syngas by contacting the gas with the MDEA solution within the H_2S absorber column. A portion of the CO_2 is also absorbed as well. The H_2S-rich MDEA from the bottom of the absorber flows to a cross heat exchanger to recover heat from the hot lean MDEA coming from the stripper. The heated rich MDEA is then directed to the H_2S stripper where the H_2S and CO_2 are removed at near atmospheric pressure. A concentrated stream of H_2S and CO_2 exits the top of the H_2S stripper and flows either to the carbon-capture system or directly to the SRU. The lean MDEA is pumped from the bottom of the stripper to the heat exchanger. The lean MDEA is further cooled before being stored and then recirculated to the absorber. This unit is a totally enclosed process with no discharges to the atmosphere.

Figure 3.1-9 Acid Gas Removal



3.1.5.3.5 Potential Carbon Capture Retrofit

The Applicant believes that some form of state of federal greenhouse gas emissions control will be imposed within the next ten years. To provide the State and consumers with a means to deal with such requirements, the Applicant will design Mesaba One and Mesaba Two to be carbon capture ready. Additionally, the Applicant has contracted with the University of North Dakota Energy and Environmental Research Center ("EERC") to assess CO_2 management options for Mesaba One and Mesaba Two. This work is part of the Plains CO_2 Reduction Partnership[5],

[5]The Plains CO_2 Reduction Partnership is one of seven regional partnerships funded by the U.S. Department of Energy's National Energy Technology Laboratory Regional Carbon Sequestration Partnership Program.

Phase II efforts EERC is conducting for DOE to validate the most promising sequestration technologies and infrastructure concepts identified during Phase I of the Program[6]. Sink-source pairs, specific to the composition of CO_2 gas streams that can be removed from the syngas produced by Mesaba One and Mesaba Two, will be identified and ranked according to engineering, economic, and public-acceptance considerations.

The carbon capture system that the Applicant will seek to engineer on a preliminary basis can be added after the IGCC plant is in operation. Based on work to date, such CO_2 capture facilities will likely be located within the existing IGCC Power Station Footprint and require an area of approximately 100' X 150' to accommodate necessary equipment. The preferred location for the future CO_2 capture equipment would be adjacent to the power block. For PRB coal, the Applicant would attempt to design facilities to capture approximately one third of the carbon (as CO_2) present in the solid IGCC feedstock. This capture would likely come at a decrease in capacity and an increase in heat rate of the IGCC plant.[7]

3.1.5.3.6 Mercury Removal and Moisturization

Fixed beds of activated carbon will be provided to remove residual mercury from syngas (see Figure 3.1-9 above). Multiple beds specially impregnated to remove mercury are used to obtain optimized adsorption. The activated carbon capacity for mercury ranges up to 20% by weight of the carbon (Parsons, 2002). The mercury removal system will remove enough mercury from the syngas so that the mercury content of the syngas fuel is no more than 10% of the mercury contained in the solid IGCC feedstock. The mercury removal system will be located immediately upstream or immediately downstream of the AGR. The location will be determined during the next engineering phase of the project by working closely with carbon suppliers to identify the optimum location. After acid gas and mercury removal, the product syngas is moisturized, heated, and diluted with nitrogen for control of nitrogen oxides (“NO_x”) before being combusted for power generation in the CTGs.

3.1.5.4 Sulfur Recovery Unit

The H_2S carried along in the acid-gas from the AGR system is converted to elemental sulfur in the SRU. This technology is based on the industry-standard Claus process involving the conversion of the H_2S to gaseous elemental sulfur and steam. The sulfur is selectively condensed and collected in molten form. See Figure 3.1-10.

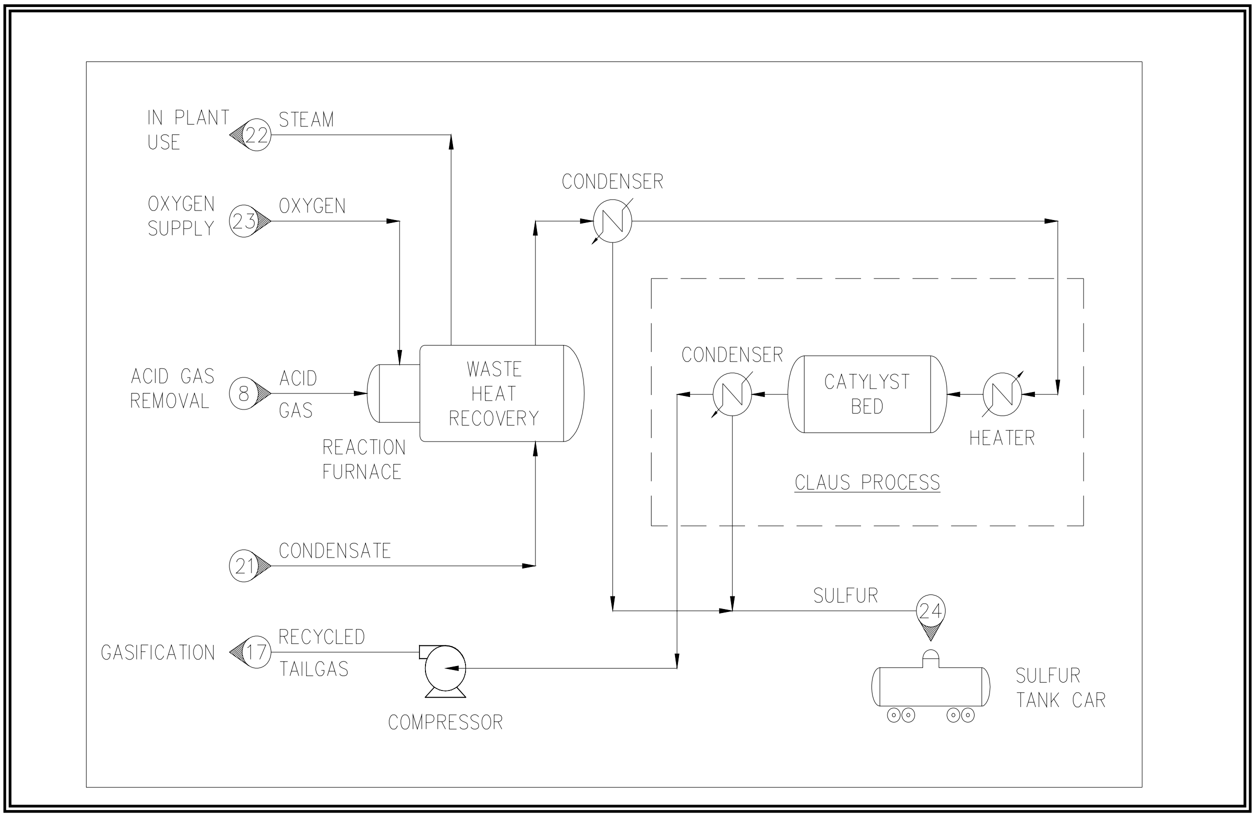
The acid gas stream from the AGR units and the CO_2 /H_2S stripped from the sour water are fed to the SRU. One-third of the H_2S is combusted with oxygen to produce the proper ratio of H_2S and

[6] Plains CO2 Reduction (PCOR) Partnership Phase I Final Report/Quarterly Technical Progress Report for the Period July 1-September 30, 2005; DOE Cooperative Agreement No. DE-PS26-03NT41982 EERC Fund Nos. 4251, 4334, 4406, and 9039, January 2006.

[7] These adverse economic and operational impacts associated with carbon capture are expected to be reduced by the research and development initiatives that are presently underway as part of the DOE’s Clean Coal Power Initiative and related efforts. Research under these initiatives are attempting to develop the technological path to permit removal of an expected 90% of total CO_2.

SO_2, which are then reacted together to produce elemental sulfur gas in a reaction furnace. A waste heat boiler is used to recover heat before the furnace off-gas is cooled to condense the first increment of sulfur. Gas exiting the first sulfur condenser is fed to a series of heaters, catalytic reaction stages, and sulfur condensers where the H_2S is incrementally converted to elemental sulfur. The sulfur is recovered and stored in molten form and may be sold as a by-product raw material for fertilizer and other beneficial uses. If not sold, the sulfur will be stored on site and/or transported to a storage facility.

Figure 3.1-10 Sulfur Recovery Unit



The tail gas from the SRU is composed primarily of CO_2 and nitrogen, with trace amounts of H_2S and SO_2, as it exits the last condenser. This SRU tail gas is catalytically hydrogenated to convert the remaining sulfur species to H_2S and then recycled to the gasifier. Recycling the SRU tail gas allows for a very high overall sulfur removal in the IGCC process and eliminates the need for a conventional tail gas treating unit and the associated SO_2 and NO_x emissions to the atmosphere.

The sulfur production rate is dependent upon the sulfur content of the feedstock, and will vary from about 30 tons per day up to about 165 tons per day per IGCC unit. The sulfur storage tanks are considered part of the SRU system.

Condensed sulfur from the SRU is collected in the sulfur pit. The liquid sulfur drains into a pit which contains a pump well and sulfur pumps. Sweep nitrogen is introduced into the pit to prevent the accumulation of an otherwise potentially explosive mixture of H_2S and air, and to control fugitive emissions. The sweep nitrogen inlet and outlet are located at opposite ends of the pit to ensure proper sweep of the vapor space. The sweep nitrogen outlet is collected and recycled to the second stage of the gasifier. Nitrogen is used instead of air as it is readily available and as it is undesirable to return air back to the gasifier's second stage.

The liquid sulfur is pumped from the sulfur pit to a sulfur degassing unit. The sulfur degassing unit strips dissolved H_2S out of the liquid sulfur. The degassed sulfur is pumped from the degassing unit to the sulfur storage tank. The stripped H_2S stream is routed to the tail gas recycle stream to the gasifier.

Sulfur loading involves pumping liquid sulfur from the sulfur storage tanks to trucks or rail cars. The sulfur loading equipment will have vapor recovery systems to control fugitive emissions by returning displaced vapors to the storage tank.

The SRU is a totally enclosed process with no discharges to the atmosphere.

3.1.5.5 Air Separation Unit

The air separation unit provides oxygen for the gasification process, and nitrogen for CTG NO_x control and purging. The ASU contains an air compression system, an air separation cryogenic distillation system ("cold box"), an oxygen pump system and a nitrogen compression system. Two ASU equipment trains will be provided for each phase of the facility.

A multi-stage, electric motor-driven centrifugal compressor compresses filtered atmospheric air that may be combined with additional compressed air extracted from the gas turbines in the power block. The combined air stream is cooled and directed to the molecular sieve absorbers where moisture, carbon dioxide and atmospheric contaminants are removed to prevent them from freezing in the colder sections of the plant. The dry carbon dioxide-free air is separated into oxygen and nitrogen in the cryogenic distillation system. A stream containing mostly oxygen is discharged from the cold box as a liquid and stored in an intermediate oxygen storage tank, from which it is fed to the gasifier.

The remaining portion of the air is mainly nitrogen and leaves the ASU in three separate nitrogen streams. A small portion of the nitrogen is high purity and is used in the gasification plant for purging and inert blanketing of vessels and tanks. The largest, but less pure, portion of the nitrogen is compressed and sent to the combustion turbines for NO_x emission control. A waste/excess nitrogen stream is vented to the atmosphere. There will be no emission of regulated air pollutants from the ASU.

3.1.5.6 Slag Handling, Storage and Loading

The slag/water slurry from the gasifier (see 3.1-6 above) flows continuously into a dewatering bin. The bulk of the slag settles in the bin while water overflows into a settler in which the remaining slag fines are settled and concentrated. The slurry of fine slag particles from the bottom of the settler is recycled to the slurry preparation area, ensuring maximum carbon utilization. The clear water from the settler is passed through heat exchangers where it is cooled as the final step before being returned to the gasifier quench section.

Dewatered slag is transferred by in-plant trucks to the slag storage area from where it will be loaded into on-road trucks or rail cars for transport to market or storage. The dewatered slag is relatively inert. It is also still very moist, and will therefore not be a source of fugitive emissions.

3.1.5.7 Combined Cycle Power Block

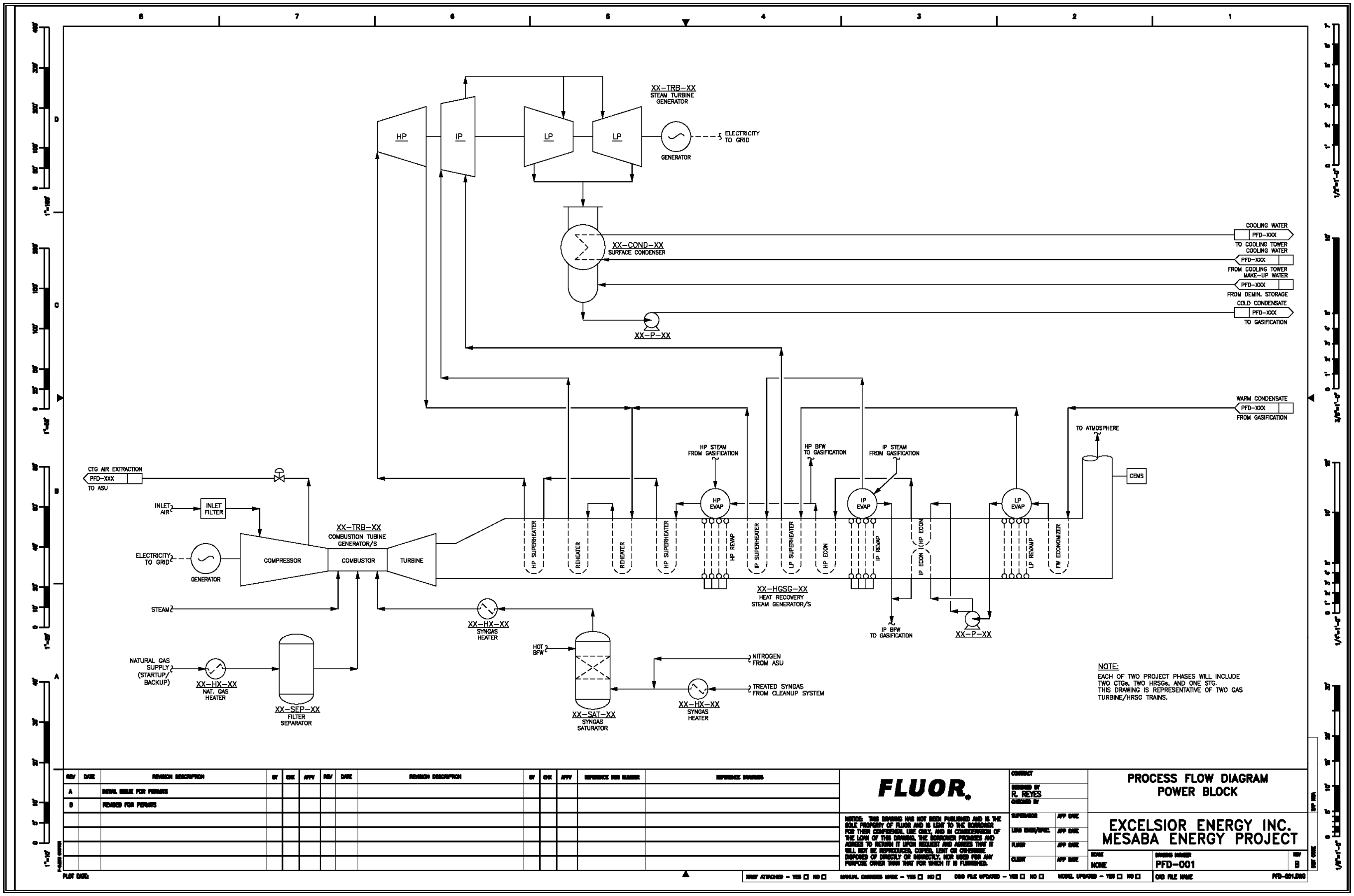
The power generation portion of the IGCC Power Station is similar to a conventional natural gas combined cycle plant. Combined cycle power generation is one of the most efficient commercial electricity generation technologies currently available. Each phase of the Project will include two "F Class" advanced CTGs configured to utilize syngas, two HRSGs, and a single STG. See Figure 3.1-11 below. The CTGs will convert the chemical energy contained in the syngas fuel to electricity both directly through the generators integral to the CTGs, and indirectly through the additional thermal energy contained in the CTG exhaust gas. The exhaust gas is converted to high-energy steam in the HRSGs and subsequently to a significant amount of additional electricity in the STG.

Preheated syngas from the gasification section and compressed air are supplied to the combustor of the combustion turbine and mixed through diffusion (a diffusion flame combustion turbine). Diluent nitrogen added to the syngas fuel reduces the flame temperature in the combustor and thereby reduces production of nitrogen oxides. The hot exhaust gas exiting the combustor flows to the expander turbine, which drives the generator to produce electricity and also turns the air compressor section of the combustion turbine. Hot exhaust gas from the expander is ducted through the HRSG to generate high-energy steam used to produce additional electricity in the steam turbine generator. Following heat recovery, the cooled CTG exhaust gas is discharged to the atmosphere through the HRSG stacks. The HRSG stacks will be provided with emission monitoring instruments as required to verify compliance with applicable emission standards and permit conditions.

The HRSG generates three pressure levels of steam and heats the boiler feed water for the syngas cooler in the gasification section. The HRSG also provides additional energy for superheating steam from the gasification section and cold reheat steam from the STG.

The steam turbine generator is comprised of high pressure ("HP"), intermediate pressure ("IP"), and low pressure ("LP") turbine sections, coupled directly to a generator. The LP turbine section exhausts to the surface condenser. Process heat from the gasification plant is used to preheat the condensate from the steam turbine condenser before it is returned to the HRSG to produce steam. STG exhaust steam is condensed in the surface condenser by indirect cooling with circulating cooling water from the cooling tower. The resulting steam condensate is recycled to the HRSG and other heat recovery equipment to once again produce steam for the STG.

Figure 3.1-11 Illustration of Combined Cycle Concept



3.1.6 Plant Utility Systems

3.1.6.1 Tank Vent Collection/Boiler System

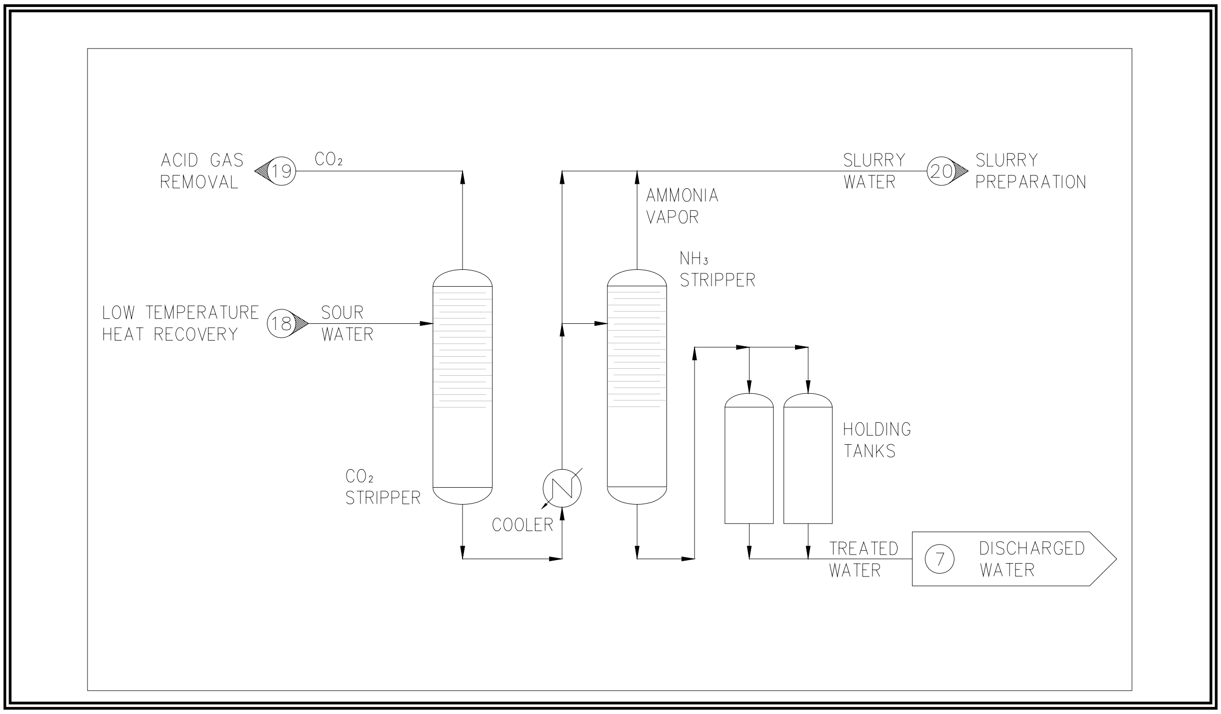
A tank vent collection/boiler system is used to convert each off-gas component in the tank vents to its oxidized form (SO_2, NO_x, H_2O, and CO_2) before venting to the atmosphere. The tank vent streams are composed primarily of air purged through various in-process storage tanks, and are routed to the tank vent boiler. This tank purge gas may contain very small amounts of sulfur-bearing components. The high temperature produced in the tank vent boiler thermally converts any H_2S present in the tank vents to SO_2. Heat recovery in the form of steam generation is provided for the hot exhaust gas from the tank vent boiler before it is directed to a stack.

The slag handling dewatering system off-gas contains H_2S which would be a source of relatively significant SO_2 emissions if vented to the tank vent system. Instead, in this part of the process, H_2S is released from slag water as the pressure is reduced from approximately 400 psig to atmospheric conditions. Rather than vent this “flashed” gas to the tank vent boiler, a blower will combine it with either the tail gas from the SRU for recycle to the gasifier or the SRU feed gas from the AGR, thus eliminating this potential SO_2 emission source.

3.1.6.2 Sour Water Treatment

Process water containing dissolved contaminant gases produced within the gasification process must be treated to remove these dissolved gases before being recycled to the coal grinding and slurry preparation area or being blown down to the Zero Liquid Discharge (“ZLD”) System. The sour water treatment process is illustrated in Figure 3.1-12. The dissolved gases are driven from the water using steam-stripping. The steam provides heat and a sweeping medium to expel the gases from the water, resulting in a water purification level sufficient for reuse within the plant and/or for blowdown to the ZLD system.

Figure 3.1-12 Sour Water Treatment



Water condensed during cooling of the sour syngas contains small amounts of dissolved gases (CO_2, NH_3, H_2S and other trace contaminants). The gases are stripped from the sour water in a two-step process. First, the CO_2 and most of the H_2S are removed in the CO_2 stripper column by steam stripping and directed to the SRU. The water exits the bottom of this column, is cooled, and a major portion is recycled to feedstock grinding and slurry preparation. The rest is treated in an ammonia stripper column to remove the ammonia and remaining trace components. The stripped ammonia is combined with the recycled slurry water. A portion of the ammonia stripped water is blown down to the ZLD, with the rest being reused within the plant. Reuse of water within the gasification plant minimizes water consumption and discharge.

This unit is a totally enclosed process with no discharges to the atmosphere.

3.1.6.3 Zero Liquid Discharge System

3.1.6.3.1 Gasification Island: West and East Range IGCC Power Station

Water from the bottom of the ammonia stripper is treated in a ZLD unit. The blowdown stream is pumped to a brine concentrator which uses steam or vapor compression to indirectly heat and evaporate water from the wastewater stream. Generated water vapor is compressed and condensed, and the high quality distillate is recycled to the syngas moisturization system or to other water uses in the plant. The concentrated brine is further processed in a heated rotary drum dryer/crystallizer. There the remaining water is vaporized and a solid filter cake material is collected for proper disposal. Use of the ZLD system effectively prevents contaminants in the feedstocks from being discharged with the plant wastewater.

3.1.6.3.2 Elimination of Cooling Tower Blowdown: East Range Site

Stringent conditions applying to discharges of mercury in the Lake Superior Basin watershed make it necessary for the East Range IGCC Power Station to eliminate all direct wastewater discharges to receiving waters (the Station will discharge sanitary wastewaters to the Hoyt Lakes POTW). Elimination of cooling tower blowdown (see Section 3.3.4.2 for a description of this non-contact cooling wastewater stream) – the only process wastewater stream to be generated by the IGCC Power Station – will be accomplished via a second ZLD system serving the power block and gasification island cooling towers. The ZLD treatment system for the Station's cooling tower blowdown would consist of three steps to optimize energy consumption: a clarifier for suspended solids removal, a reverse osmosis ("RO") system to concentrate the dissolved solids, and a brine concentrator/crystallizer to remove water from the dissolved solids.

The cooling tower blowdown water and other non-oily water streams will be processed first via a clarifier to remove suspended solids. The sludge generated will be processed through a dewatering system consisting of a thickener/filter press. The 25% dry cake produced will be trucked offsite for disposal. Trace levels of ferric chloride or ferric sulfate would be added to promote flocculation. The sludge is expected to be non-hazardous and will be tested to confirm such condition.

The overflow from the clarifier will be sent via pressure filters to a reverse osmosis system. The permeate or product water will be recycled to the cooling tower basin to reduce makeup water usage (a 75% recovery is expected). The concentrated reject from the RO will be sent to a ZLD comprised of a mechanical vapor recompression ("MVR") evaporator or similar equipment and crystallizer and the concentrated crystals will be disposed offsite and the recovered distillate will be sent to the boiler feed water mixed bed unit for further polishing and reuse in the HRSGs. The crystallized solids are expected to be non-hazardous. Any excess distillate water can be returned to other water users or the cooling tower basin.

The cycles of concentration ("COC") in the cooling towers will be maintained between 8 and 10 cycles because of the high magnesium and sulfate in makeup water from Mine Pit No. 6 (see Section 3.4.1.1.6).

3.1.6.4 Auxiliary Boilers

Two auxiliary boilers, one for each phase of the IGCC Power Station, will provide steam for pre-startup equipment warmup and for other miscellaneous purposes when steam from the gasifiers or HRSGs is not available. These boilers will provide steam in addition to, or in lieu of, the steam that can be generated from the tank vent boilers. Each boiler will produce a maximum of about 100,000 lb/hr of steam and will be fueled by only pipeline natural gas. Annual operation of each boiler will be at or less than 25% of the year at maximum capacity. Boilers will be equipped with low NO_x burners to minimize emissions.

3.1.6.5 Flare

The gasification island elevated flare is utilized to burn partially combusted natural gas and scrubbed/desulfurization off-specification syngas during unit startup or on-specification syngas during short-term combustion turbine outages. Syngas sent to the flare during normal planned flaring events will be filtered, water-scrubbed and further treated in the AGR and mercury removal systems to remove regulated contaminants prior to flaring. Flaring of untreated syngas or other streams within the plant will only occur as an emergency safety measure during unplanned plant upsets or equipment failures. The elevated flare is estimated to be approximately 185 feet in height.

One 2 MW emergency diesel generator will be used for the gasification island and a 350 kW emergency diesel generator will be used for the power block. One or two nominal 300 hp diesel-driven firewater pumps will be provided for each phase (emission estimates are based on having two firewater pumps per phase). These engines will burn very low sulfur distillate oil. Other than plant emergency situations, the engines will be operated less than five hours per month per engine for routine testing, maintenance, and inspection purposes.

3.1.7 Major Process Equipment

The major functional process equipment provided for the inside the boundary limit (ISBL) facilities for the IGCC Power Station are identified below. The number of trains and percentage train capacity for each of the functions/components are also identified. Capacities for some of the major components are identified.

3.1.7.1 Air Separation Unit (2x 50%)

- Air Separation Unit (2,507 tons per day/train, based on PRB1 coal operation)
- N_2 Booster Compressor for CTG Injection
- Liquid Oxygen and Liquid Nitrogen storage

3.1.7.2 Feedstock (Coal/Petroleum Coke) Handling (1 x 100%)

- Feedstock Active Storage (20 days based on PRB1 coal)/Conveying/Reclaiming (based on 8,550 tons/day, as received)
- Feedstock Inactive Storage (45 days based on PRB1 coal)
- Flux Storage (silos)/Conveying/Reclaiming (250 tons per day based on 50:50 blend of PRB2:PRB3 coals)
- Rotary Railcar Unloading Facilities and Thaw Shed (Feedstock)
- Dust Collectors for enclosed feedstock storage areas
- Truck Unloading Facilities (Flux)

3.1.7.3 Gasification Island (3 x 50%)

- Coal Grinding and Slurry Preparation (2 x 60%)
- Gasification (4,275 tons per day design coal, as received, per gasifier, based on PRB1 coal)
- High Temperature Heat Recovery
- Dry Char Removal
- Slag Grinding (1 x 100%)
- Slag Dewatering (1 x 100%)

- Slag Storage and Loading System (1 x 100%) (800 tons per day [wet basis], based on 50:50 blend of PRB2:PRB3 coals)

3.1.7.4 Syngas Treating (2 x 50%)

- Gas Scrubbing
- Low Temperature Syngas Cooling
- COS Hydrolysis
- Recycle Gas Compression
- Acid Gas Removal
- Acid Gas Enrichment (1 x 100%)
- Mercury Removal
- Syngas Moisturization
- Sour Water System (1 x 100%)

3.1.7.5 Sulfur Recovery and Tail Gas Recycle (2 x 50%)

- Claus Plant Sulfur Recovery (O_2-Blown), (Up to 83 tons per day/train, based on high sulfur Illinois #6 operation)
- Molten Sulfur Storage
- Molten Sulfur Truck/Rail Loading Facilities (1 x 100%)
- Tail Gas Recycle (1 x 100%)
- Tank Vent Gas Incineration (1 x 100%)

3.1.7.6 Power Block

- CTG (2 x 50%) (232 MW nominal each, based on Siemens-Westinghouse SGT6-5000F combustion turbine assumed for environmental permitting)
- Heat Recovery Steam Generator and Exhaust Stack (2 x 50%)
- Steam Turbine-Generator (1 x 100%), (Up to 300 MW nominal)
- Surface Condenser (1 x 100%)
- Vacuum, Condensate and Boiler Feedwater Systems (1 x 100%)
- Power Block Circulating Water System
- Raw Water/Demineralizer Water Tankage/Pumps
- Demineralizer System
- Filtered Raw Water, Firewater/Tankage/Pumps
- Wastewater Collection/Wastewater Separation
- Plant and Instrument Air
- Step-up Transformers

3.1.7.7 General Facilities (1 x 100%)

- Gasification/ASU Cooling Water/Tower System
- Zero Liquid Discharge Unit (for Process Condensate Blowdown)
- Process Condensate Blowdown Holding Tank
- Gasification Unit Flare

- Emergency Diesel Generator
- Natural Gas Distribution
- Drains and Blowdowns
- Nitrogen Distribution
- Potable and Utility Water
- Sanitary Sewage System
- Storm Water Collection and Treatment

3.1.7.8 Dominant Structures and Other Buildings Associated With the IGCC Power Station

From visual and air quality modeling perspectives, the dominant structures on site include the following:

- Combustion Turbine Generator Building (230 feet x 180 feet x 75 feet high)
- Steam Turbine Generator Building (170 feet x 140 feet x 90 feet high)
- Air Separation Unit Building (375 feet x 140 feet x 70 feet high)
- Heat Recovery Steam Generator (110 feet x 55 feet x 90 feet high)
- Rod Mill Feed Bins (155 feet x 25 feet x 150 feet high)

These structures and their proximity to the IGCC Power Station's point and fugitive emission sources are identified in Figure 3.1-1 and Figure 3.1-2. The finished grade elevations of the West Range IGCC Power Station Footprint are provided in Figure 3.2-3. The East Range grade elevations are provided in Figure 3.2-5

Other buildings associated with the IGCC Power Station include the control room, administration building, warehouse/maintenance shop, combustion turbine and steam turbine buildings, weather enclosures for the ASU compressors, slurry preparation, water treatment/lab, railcar thaw shed, switchyard control room, several power distribution centers, and a visitor's center.

3.1.8 Expected Process Operating Characteristics

The IGCC Power Station will be designed to process a relatively wide variety of feedstocks, including sub-bituminous coal, bituminous coal and petroleum coke. As noted previously in Section 3.1.3, feedstock variability has been considered along with critical components and operating conditions known to influence plant performance (for example, the combustion turbine selected, its operating mode, the operating mode of the gasifier, and ambient conditions) to identify the operating conditions which would provide a reasonable upper limit or "worst case" scenario for potential pollutant emissions/discharges. Table 3.1-1 quantifies such conditions assuming operation of the gasifier in PSQ mode while Table 3.1-2 assumes operation of the gasifier in FSQ mode. Pollutant emissions, discharges, and waste products are quantified assuming the conservative PSQ conditions (see Section 3.4).

Table 3.1-1
Key Performance Indicators Used to Assess Worst Case Environmental Impacts of IGCC Power Station (Phase I, PSQ Mode)

Performance Parameter	Estimated Range	Comments
CTG gross power, MW	440	Total for two CTGs
STG gross power, MW	265 - 300	Varies depending on quantities of steam generated by Gasification Island and HRSGs
Net plant generation, MW	580 - 606	Output from CTGs plus STG, less internal consumption and losses
Coal/coke feed rate, tons/day (as received)	5,300 -8,550	Feed rate to gasifiers
Coal/coke feed energy, million Btu/hr (HHV)	5,280 – 5,910	Energy content of gasifier feedstock
Product syngas energy, million Btu/hr (HHV)	4,190 – 4,368	Energy content of syngas fuel delivered to CTGs
Coal conversion efficiency	0.71 – 0.80	Fraction of solid feedstock energy in syngas feed to CTGs
Net overall heat rate, Btu/kW-hr (HHV)	8,900 – 9,500	Solid feedstock energy used per unit of net electricity to grid
Flux feed, tons/day	0 - 250	Process additive for gasifier feedstock
Slag by-product production, tons/day	500 - 800	Varies depending on feedstock composition and flux use
Sulfur by-product production, tons/day	30 – 165	Varies depending on feedstock composition

Table 3.1-2
Expected IGCC Power Station Operating Characteristics (Phase I, FSQ Mode)

Feedstock:	PRB-1	PRB-1	PRB-1	50/50 Wt% PRB2/PRB3	Illinois No. 6	Sizing Basis
Ambient Temperature:	38°F	80°F	-20°F	38°F	38°F	
Power Generation						
SW SGT6-5000F CTG (x2)	440 MW	440 MW	440 MW	440 MW	440 MW	440 MW
Steam Turbine-Generator	300 MW	300 MW	288 MW	N/A	N/A	300 MW
Gross Power	740 MW	741 MW	728 MW	N/A	N/A	741 MW
Less ASU Auxiliary Load	- 98 MW	-106 MW	- 97 MW	N/A	N/A	N/A
Less Internal Consumption	- 37 MW	- 37 MW	- 35 MW	N/A	N/A	N/A
Net Power (for Export to Grid)	606 MW	598 MW	596 MW	N/A	N/A	606 MW
Coal Feed (as received), tons/day	8225	8119	8136	7397	5477	8225

Feedstock:	PRB-1	PRB-1	PRB-1	50/50 Wt% PRB2/PRB3	Illinois No. 6	Sizing Basis
Coal Feed (dry), tons/day	5716	5643	5655	5461	4957	5716
Coal Feed (HHV), MMBtu/hr	5688	5616	5627	5592	5288	5688
Plant Heat Rate (HHV), Btu/kWh	9391	9397	9439	9412	9033	N/A
Oxygen Feed (contained), stpd	5014	4950	4960	5005	3894	5014
Flux Feed, stpd	0	0	0	233	0	
Design capacity, stpd						233
Slag Produced, stpd	501	495	496	774	772	
Design capacity, stpd						774
Sulfur Produced, stpd	30	29	29	45	162	
Design capacity, stpd						162

The composition and properties of the product syngas will vary depending on the solid feedstocks processed and Power Station operating conditions.

Table 3.1-3 shows the expected range of syngas composition and fuel heating value.

Table 3.1-3
Estimated Product Syngas Composition Multiple Feedstock Plant (Phase Independent)

Component [1]	Range
Hydrogen, vol %	30 – 40
Carbon monoxide, vol%	35 – 50
Carbon dioxide, vol%	13 –26
Methane, vol%	1 – 5
Nitrogen plus argon, vol%	2 – 3
Higher heating value, Btu/scf [2]	240 – 305

[1] Parameters shown for dry syngas fuel prior to nitrogen dilution.
[2] Standard conditions defined as 60 ^{o}F, one atmosphere pressure.

3.2 IGCC POWER STATION FOOTPRINT

3.2.1 Site Independent Features

The IGCC Power Station Footprint for Mesaba One will encompass about 100 acres. An additional 80 acres of land will be required for a temporary construction laydown area for Mesaba One equipment, and five acres for a concrete batch plant. Current plans call for the Mesaba Two Footprint to be very similar to that for Mesaba One (requiring a IGCC Power Station Footprint of about 200 acres total). As required during construction of Mesaba One, Mesaba Two would require an additional 80 acres of land for a temporary construction laydown area and five acres for a concrete batch plant.

Figure 3.2-1 illustrates the layout plan for Mesaba One and Mesaba Two. An artist's visualization of the Phase I and II Developments is shown in Figure 3.2-2 (the visualization does not reflect the Site-specific grading plans outlined for the Phase I and II Developments in the following two subsections). The final surfaces proposed for the Phase I and II Developments are shown in Figure 3.2-6 and a drainage plan is provided in Figure 3.2-7.

The final surfaces proposed for the Phase I and II Developments are shown in Figure 3.2-6 and a drainage plan is provided in Figure 3.2-7.

Easements across public and private lands will be required for the IGCC Power Station's Associated Facilities and Additional Lands. The location of such easements is Site specific. The Site-specific plans for such easements are discussed Section 7 and Section 8 for the West Range and East Range Sites, respectively.

3.2.2 West Range Site

Figure 3.2-3 provides a preliminary grading plan that shows how the Phase I and II Developments within the IGCC Power Station Footprint will be accommodated. Figure 3.2-4 provides the cross sections of the Phase I and II Developments that are identified on Figure 3.2-3. Additional Lands required to accommodate Associated Facilities outside the IGCC Power Station Footprint are discussed in Section 7. High surficial groundwater levels in soils in the vicinity of the West Range IGCC Power Station may require permanent water table control measures beyond temporary construction dewatering.

3.2.3 East Range Site

The grading plan for the East Range IGCC Power Station Footprint is shown in Figure 3.2-5. The East Range plan will not require the same degree of "terracing" as the West Range IGCC Power Station Footprint. The grading plan for the East Range Site will result in about a 10-foot change in elevation from one side of the Station's Footprint to the other (the change in elevation across the West Range IGCC Power Station Footprint varies about 50 feet). Additional accommodations must be made within the Station Footprint for the additional ZLD system not required at the West Range Site, sized to totally eliminate discharges of cooling tower blowdown (See Section 3.6.1.2).

Figure 3.2-1 Phase I and II IGCC Power Station Layout

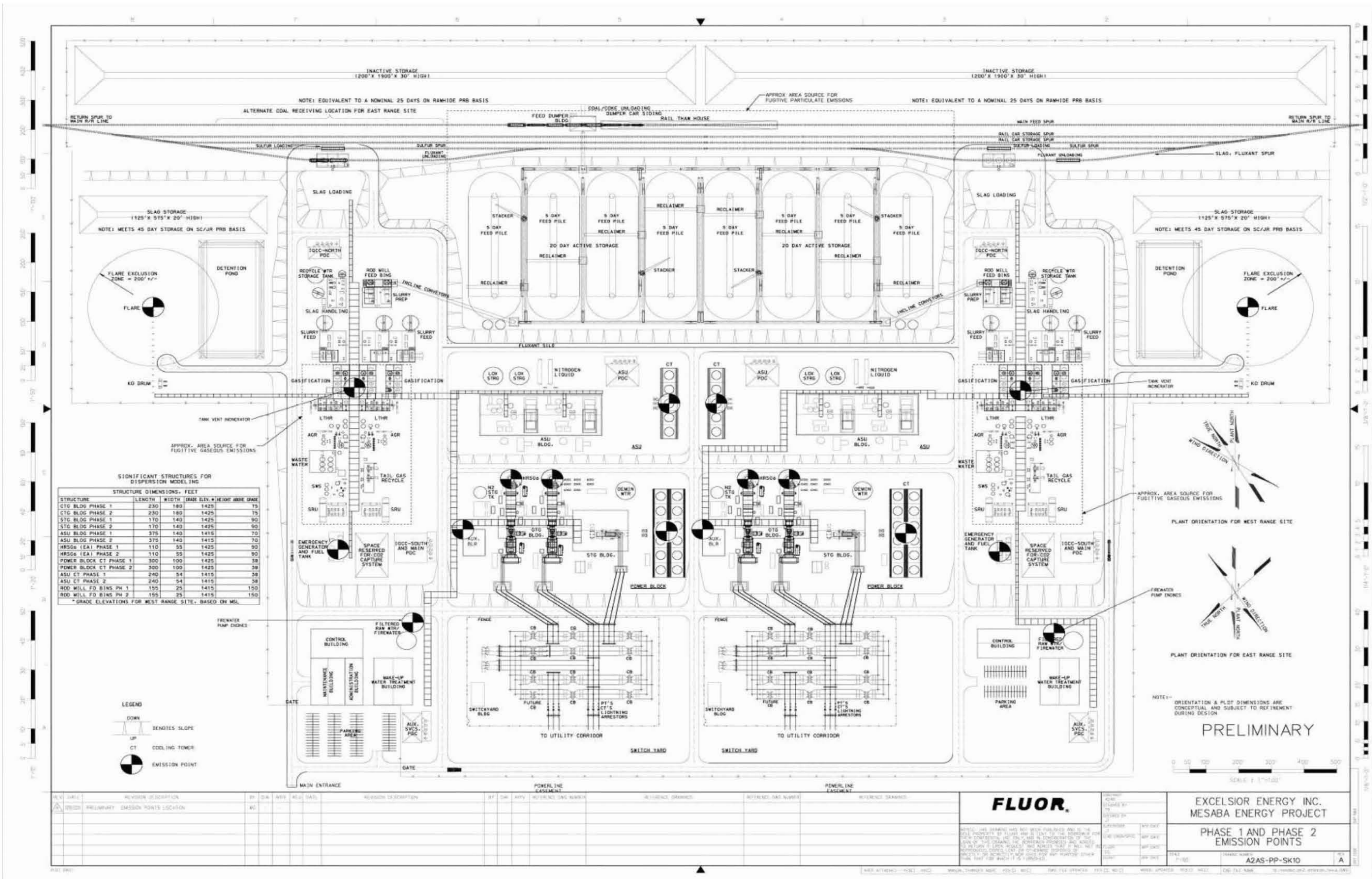


Figure 3.2-2 Artist's Visualization of Phase I and Phase II IGCC Power Station

Figure 3.2-3 Preliminary Grading Plan for Phase I and II IGCC Power Station on West Range Site

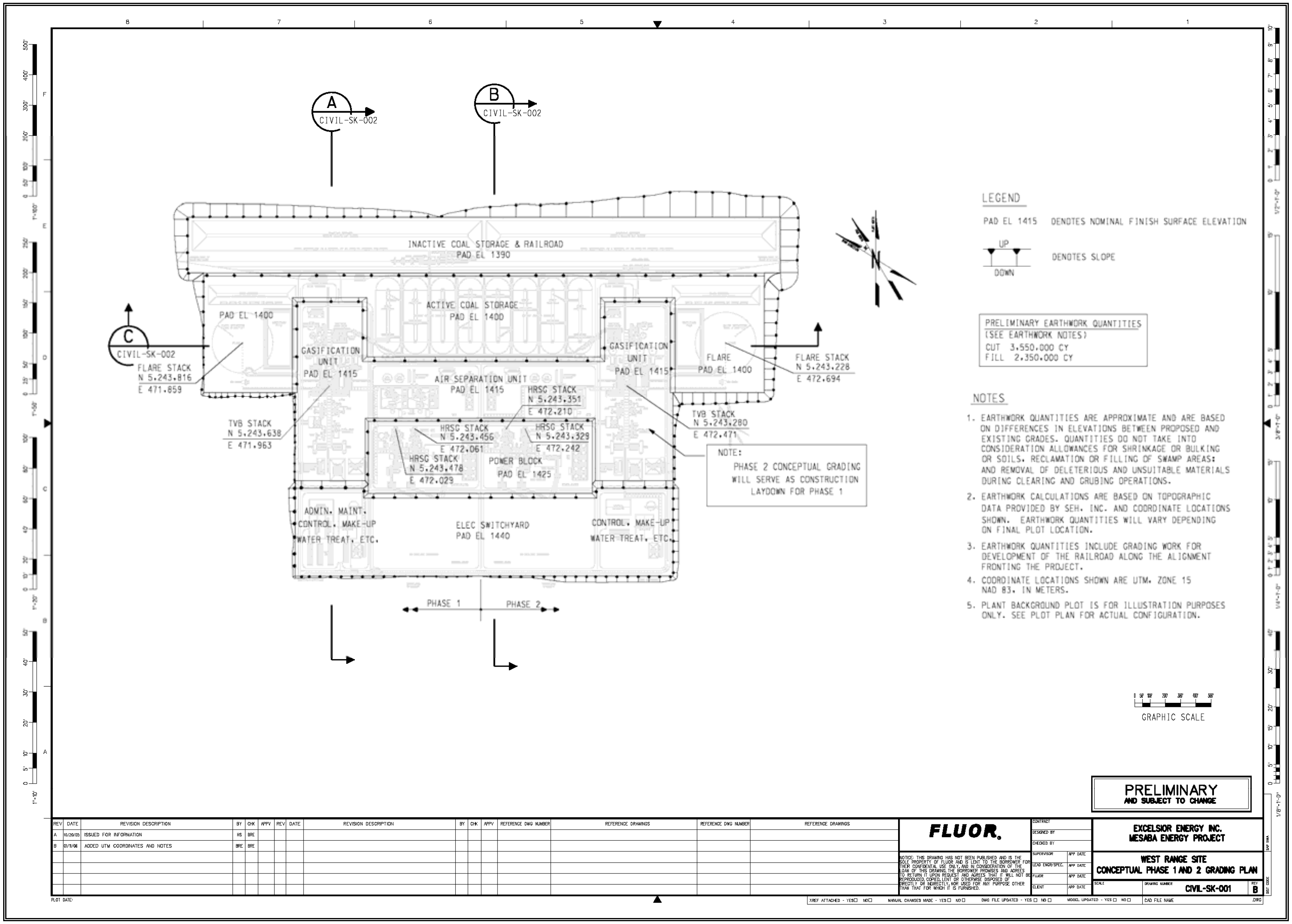


Figure 3.2-4 Cross Sections of Phase I and II IGCC Power Station on West Range Site

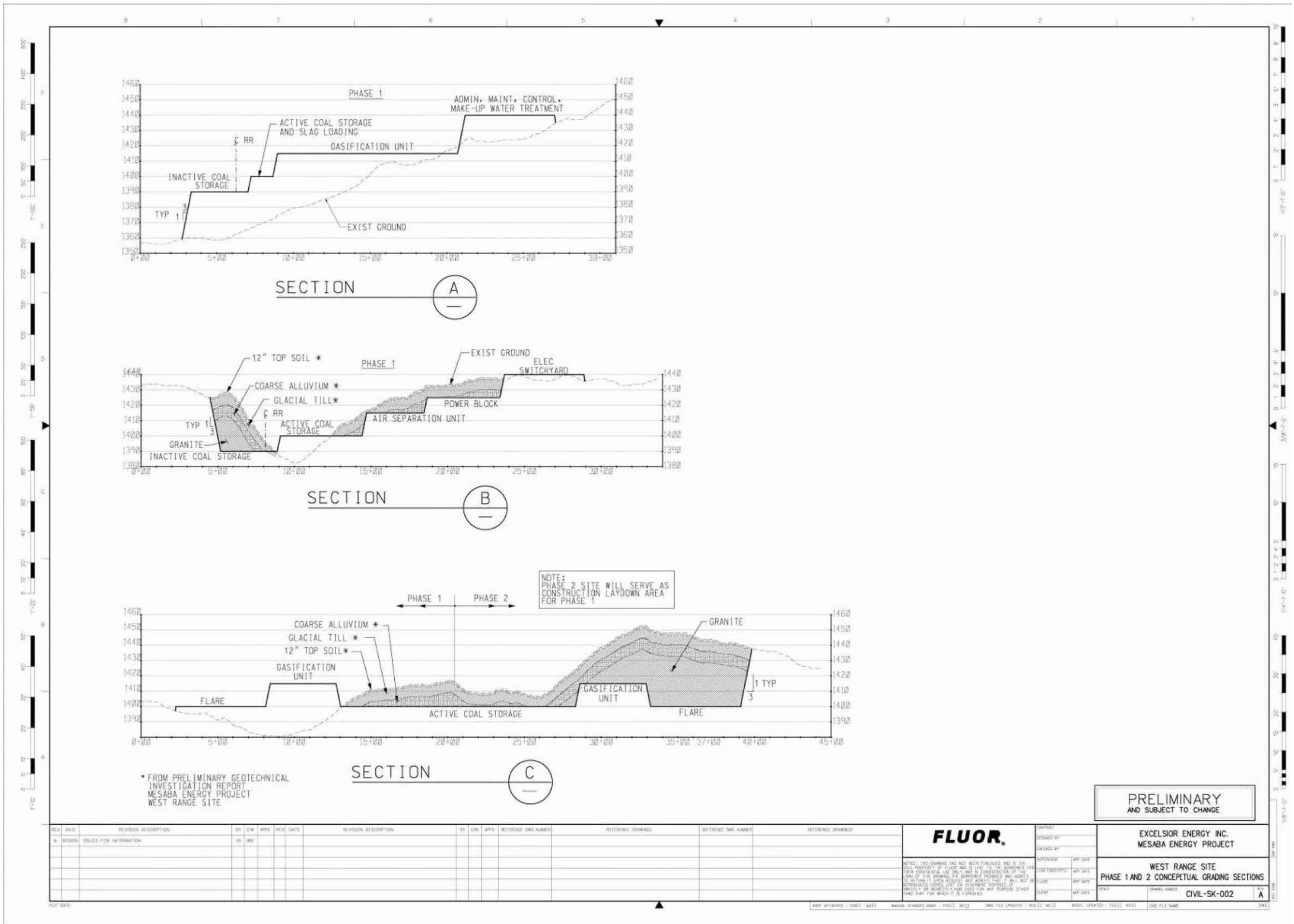


Figure 3.2-5 East Range Grading Plan

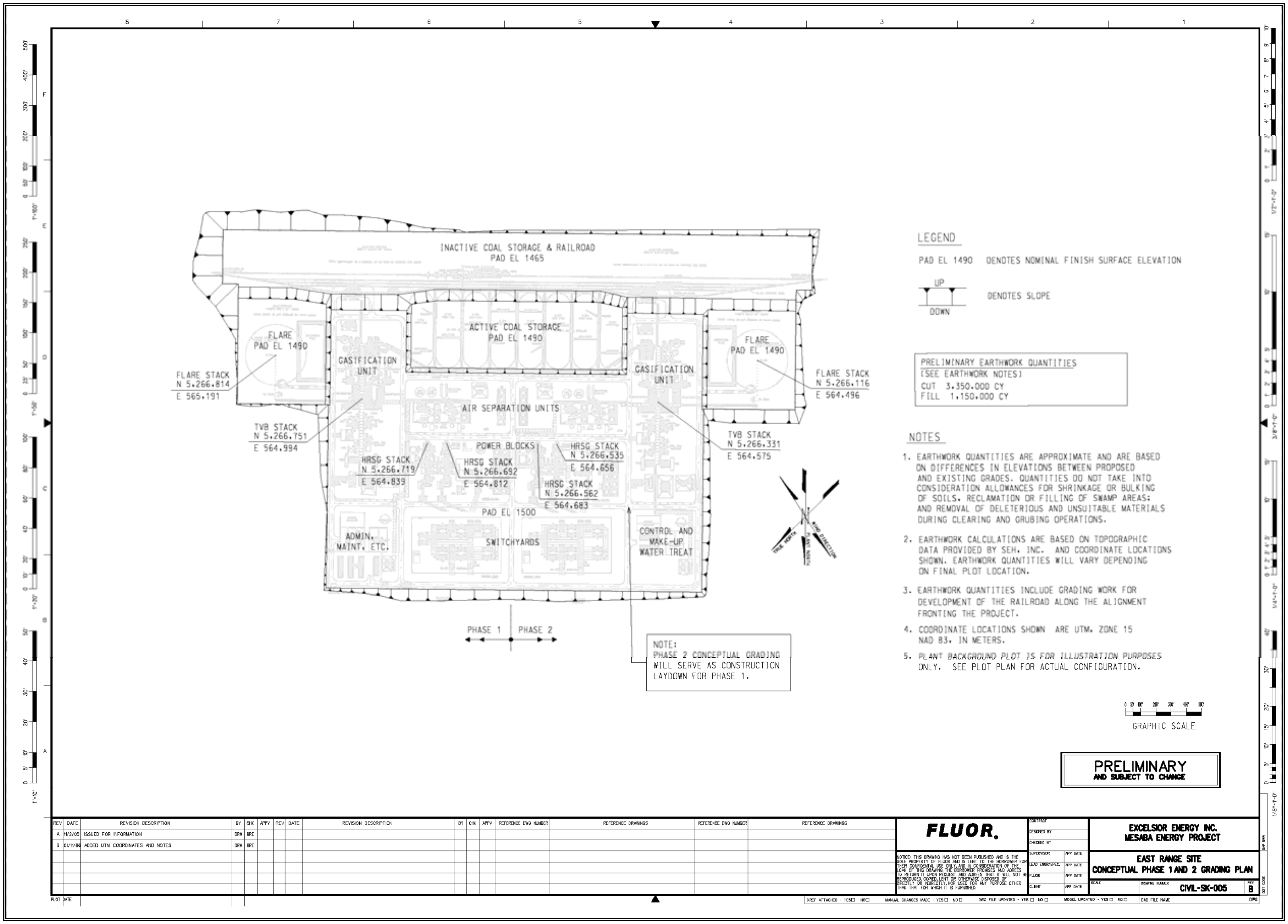


Figure 3.2-6 Surfacing Plan for Phase I and II Developments

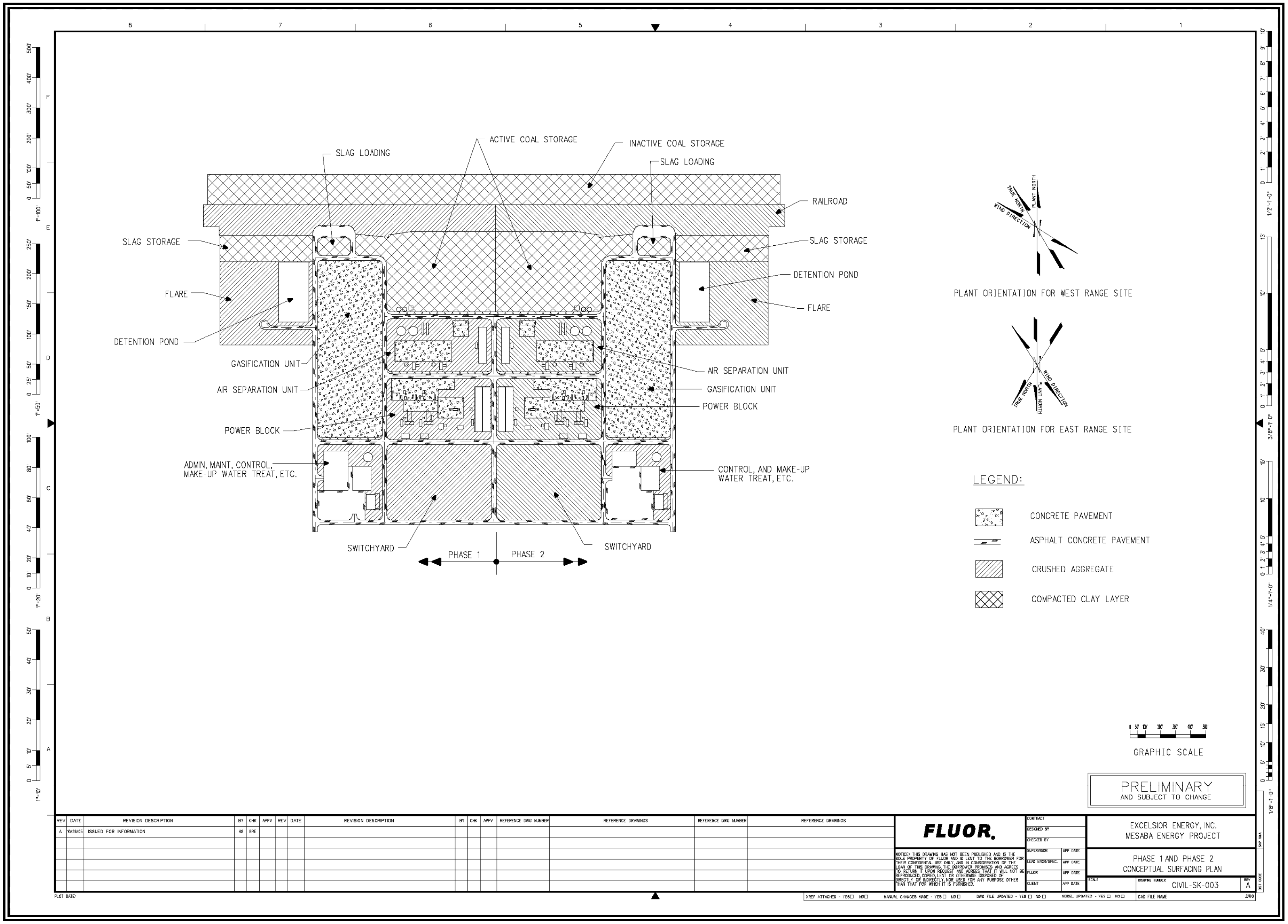
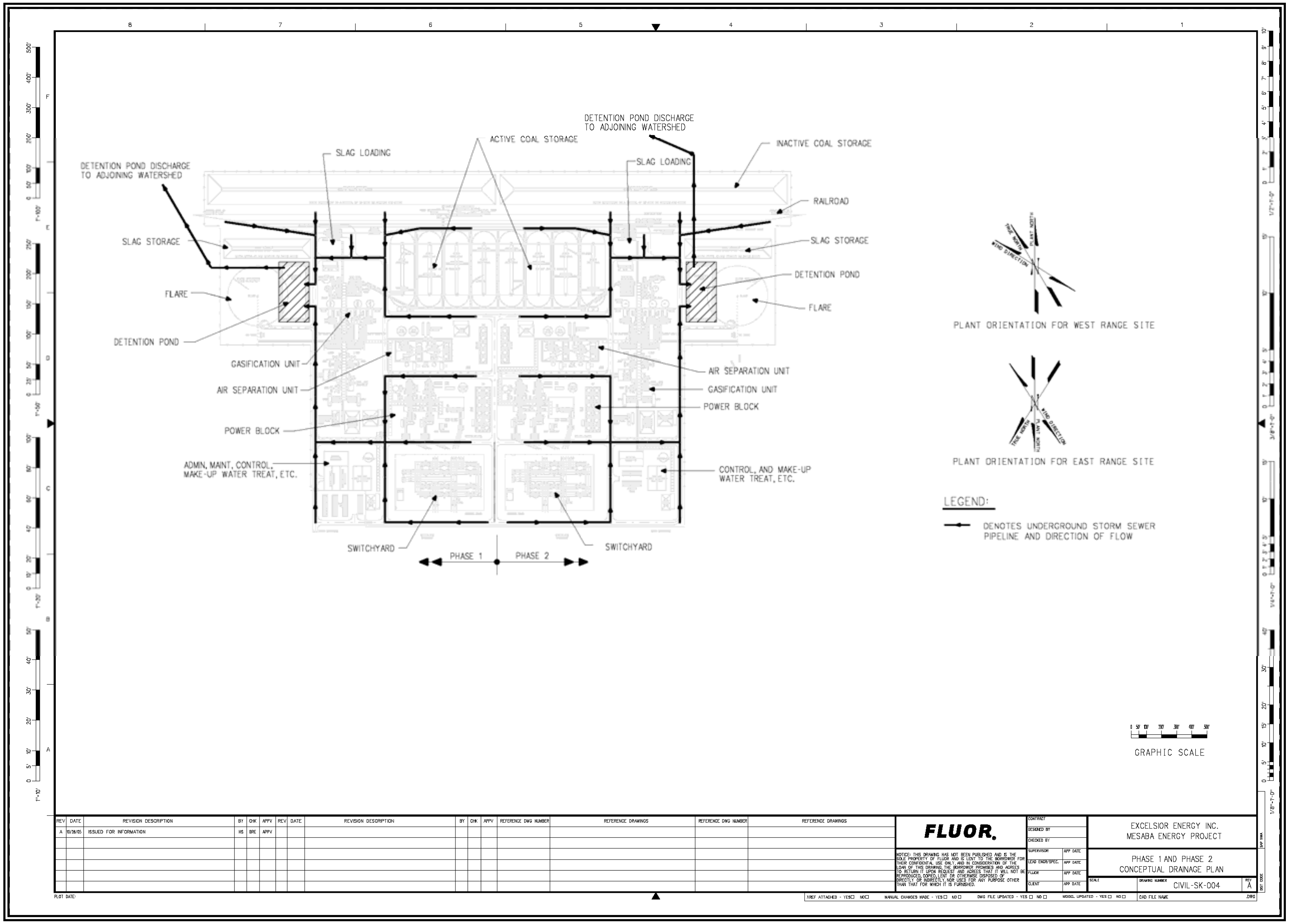


Figure 3.2-7 Current Drainage Plan for Phase I and II Developments



3.3 RESOURCE INPUTS

3.3.1 Feedstocks

3.3.1.1 Delivery

Coal and petroleum coke feedstocks will normally be received by rail in dedicated unit trains from the mine or refinery. Rail access to the West Range IGCC Power Station is from existing BNSF Railway and Canadian National Railroad tracks; rail access to the East Range Site is limited to the Canadian National Railroad. The rail loop at either location will be designed to accommodate unit trains up to 135 cars in length with the average unit train shipment expected to be comprised of 115 cars. Each unit train car will carry on average about 119 tons of feedstock (BNSF, 2005).

Each phase of the IGCC Power Station, under the maximum feedstock input case and assuming gasifier operations in FSQ mode, will require a maximum of 8,230 tons of coal per day on an as received basis. Assuming PSQ operation of the gasifiers, the daily maximum would increase to 8,550 tons on an as-received basis.

One 135 car unit train can deliver about 16,100 tons of coal and each 115 car unit train about 13,700 tons. With Mesaba One and Two operating at full load with the gasifiers in FSQ mode, a maximum 16,460 tons of coal feedstock per day will be consumed, requiring the delivery of about five 115 car unit trains every four days (slightly more than one 115 car unit train per day). With the gasifiers operating in PSQ mode, Mesaba One and Two would require under full load operations a maximum of about 17,100 tons of coal per day, thus not substantively changing the worst case, short term fuel delivery schedule. Approximately four hours time will be required to unload one unit train. Three unit trains per day (midnight to midnight) is the maximum fuel shipment that could be received and unloaded at the plant, but such a schedule would not normally occur.

Mesaba One will utilize approximately 2.7 million tons of feedstock annually assuming operation at a 90 percent capacity factor. Fuel selection throughout the lifetime of the Power Station is expected to be made pursuant to a competitive solicitation process, with selection based upon the terms offered by various suppliers and transportation rate considerations.

The availability of multiple rail transportation modes at a site will enhance the long-term benefits of the fuel-flexible plant design. An important element in the site selection process addressed whether a site could be served by more than one rail provider via its own trackage. This capability introduces the potential for competition into the fuel supply equation and should result in lower fuel costs over the life of the Project relative to what they would be absent such rail competition. The West Range Site offers two major coal transport alternatives, the BNSF and CN, each having direct access to the IGCC Power Station by the construction of short spurs to the Station Footprint. The East Range Site has the CN within immediate vicinity of the Station Footprint, and also has the potential physical capability to receive shipments of fuel via water at Taconite Harbor, with transportation to the site via CE’s 70 mile rail line which served the former LTV Mining operations. This alternative is not considered to be cost competitive with the CN rail alternative under current market conditions.

3.3.1.2 Receiving and Storage

The feedstock handling system will include facilities necessary to unload solid feedstock materials, convey them to storage areas, store them until required, reclaim them from storage, blend them as necessary, and convey the blended materials to the slurry preparation system. On-site storage facilities will be provided for two feedstock materials, coal and petroleum coke. Storage facilities will also be provided for flux, a feedstock conditioning material. The feedstock storage facilities will include, for each phase of the facility, approximately 20 days of active storage and approximately 25 days of inactive storage. The storage areas will incorporate dust suppression systems (including covered conveyers and other enclosures, dust suppression sprays, and vent filters) and will be paved, lined, or otherwise controlled to enable collection and treatment of storm water runoff and prevent infiltration to ground water of chemical species leached from feedstock materials and/or flux.

Unloading facilities will include a thawing shed to loosen frozen cargo during the winter season, and a partially enclosed rotary car dumping system. After the locomotive on a unit train positions the first car in the rotary dumper, subsequent cars are placed in the dumping position by an automatic electro-hydraulic positioner. Such rail car positioning systems reduce the run time of the locomotive or switch engine and the emissions that would otherwise occur if engines were required to run during the entire unloading process (the rail car unloading system allows all but one engine to be shut down, that engine being operated at a reduced load to maintain air pressure in the brakes). Feedstock materials fall from the rotated cars into an enclosed pit from which such materials are transferred via a feeder/conveyor system to active storage pile stackers. Four active storage piles for each phase of the facility will provide working feedstock storage. Additional inactive storage will be located on the opposite side of the rail sidings to provide a reserve source of feedstock material in the event normal deliveries of unit trains are interrupted. If needed, feedstock from the inactive pile will be moved by mobile equipment (bulldozers, scrapers, and/or front-end loaders) to the rail unloading pit to access the automated plant feed system. Reclaimers and conveyors will move coal/petcoke from the active piles to the slurry feed preparation area.

The feedstock handling/storage systems and their associated emission controls are further reviewed in Sections 3.4.1.1.5 and 3.4.1.1.6 where annual estimates of fugitive particulate matter emissions attending operation of the IGCC Power Station are provided.

3.3.1.3 Feedstock and Feedstock Characteristics

Mesaba One and Mesaba Two are designed to be "fuel flexible" throughout their economic lifetime. While conventional pulverized coal (PC) fired power plants can sometimes use a limited range of fuels, they must be designed for a specific performance fuel. When using other fuels, the performance and output of these PC plants typically deteriorate. Fuel flexibility will allow the Mesaba One and Mesaba Two to operate at or near maximum capacity using:

- 100% bituminous coal (for example, Illinois No. 6 coal)
- 100% sub-bituminous coal (for example, Power River Basin coal)
- Up to a 50:50 coal/petroleum coke ("pet coke") blend
- Other blends of these fuels

This fuel flexibility, made possible by the use of IGCC technology and the design parameters for the Applicant's IGCC Power Station, will provide ongoing future cost benefits because it allows the Station to adapt its fuel mix over the life of the facility to minimize the cost of power. Fuel flexibility provides Mesaba One and Mesaba Two a hedge against physical dependency upon a single fuel supplier or transportation provider, and in the event of supply disruptions from any mine or carrier. Table 3.3-1 presents the feedstock design specifications being utilized to design the Project's unique feedstock flexibility.

Although the primary fuel source for electric power production will be coal-derived synthesis gas, the Project will also be capable of operating on pipeline natural gas. The power island is a combined-cycle unit, optimized for operation on syngas. This ability to operate on natural gas provides an additional source of available generating capacity (and reliability for periods when the gasification island is unavailable). In addition, it offers the option of installing the combined-cycle power island early in the construction process (that is, ahead of the gasification island), thereby allowing for electricity production from natural gas until the gasification island is installed and the unit begins full base load operation on coal-derived syngas. Although not currently planned for Mesaba One and Mesaba Two, the ability to come online early using natural gas is a very useful resource planning option for subsequent units. The Applicant will propose permits to allow for natural gas firing at capacity factors of 30 percent, 20 percent, 10 percent, and 5 percent for years 1, 2, 3, and thereafter, respectively.

Table 3.3-1 Feedstock Design Specification Basis

Feedstock	Bituminous Illinois No.6 Coal		Sub-Bituminous PRB Coal		Petroleum Coke	
	Dry Basis	As Rcvd.	Dry Basis	As Rcvd.	Dry Basis	As Rcvd.
HHV, Btu/lb	12,802	11,586	11,942	8,300	15,204	13,699
Ultimate Analysis, Wt %						
Carbon	70.79	64.06	69.9	48.58	87.32	78.71
Hydrogen	4.81	4.35	4.8	3.34	3.67	3.31
Nitrogen	1.51	1.37	0.9	0.63	1.31	1.18
Sulfur	3.32	3.00	0.53	0.37	6.27	5.65
Oxygen	6.92	6.26	16.77	11.66	0.72	0.65
Chlorine	0.14	0.13	<0.01	0.01	0.01	0.01
Ash	12.51	11.32	7.1	4.93	0.7	0.63
Total	100.00	90.50	100.0	69.50	100.00	90.10
Moisture, %		9.5		30.5		9.9
Ash Mineral Analysis, Wt%						
SiO_2	49.57	NA	31.2	NA	20.55	NA
Al_2O_3	19.32	NA	13.9	NA	9.11	NA
TiO_2	0.96	NA	1.1	NA	0.8	NA
Fe_2O_3	19.32	NA	6.3	NA	5.44	NA
CaO	3.81	NA	24.3	NA	11.77	NA

Feedstock	Bituminous Illinois No.6 Coal		Sub-Bituminous PRB Coal		Petroleum Coke	
	Dry Basis	As Rcvd.	Dry Basis	As Rcvd.	Dry Basis	As Rcvd.
MgO	1.01	NA	6.1	NA	3.64	NA
Na_2O	0.46	NA	1.7	NA	1.68	NA
K_2O	2.40	NA	0.2	NA	0.66	NA
P_2O_5	0.35	NA	0.5	NA	0.52	NA
SO_3	2.07	NA	13.6	NA	23.75	NA
NiO	NA	NA	NA	NA	4.68	NA
V_20_5	NA	NA	NA	NA	16.11	NA
Other	0.73	NA	1.1	NA	1.29	NA
	100.0		100.0		100.0	
Ash Fusion Temp. (Reducing), ^oF						
Initial Deformation	2000	NA	2170	NA	2440	NA
Softening (H=W)	2150	NA	2180	NA	2500	NA
Hemispherical (H=1/2w)	2185	NA	2190	NA	2550	NA
Fluid	2370	NA	2200	NA	2600	NA
Hardgrove Grindability Index	50-65	NA	80	NA	53	NA

3.3.2 Flux Receiving and Storage

The E-Gas™ gasifier will operate at high temperatures. At such temperatures, ash in feedstock material will normally melt and drain to the bottom of the gasifier where it will be removed. The molten ash – known as slag – will be cooled in a water bath outside the gasifier until it solidifies.

Mineral matter in the ash determines the temperature at which ash in the gasifier will melt and slag viscosity at a specific operating temperatures. If the slag is too viscous, it will not easily flow from the gasifier, or could plug the bottom. Flux, typically silica/sand, limestone, iron oxide (or iron ore), or a mixture of these, will be blended with the feed as necessary to control the slag melting point and fluidity. A slag that is too fluid could be excessively erosive to the refractory in the gasifier, so the amount and composition of flux, if used, will be carefully monitored and controlled.

Flux will normally be received by truck (or railcar) and pneumatically conveyed to enclosed storage silos equipped with fabric filters for dust control. Flux from storage silos will be automatically blended with feedstock by a weigh belt feeder system. The required quantity of flux will be a small fraction of the total feed, typically less than 250 tons per day per phase.

3.3.3 Natural Gas Supply Pipeline and Metering Station

As noted in Section 1.0, 2.3, and 3.3.1.3, natural gas will be used to start up the facility and as a backup fuel. When operating on natural gas, the Power Station cannot achieve the nominal 606

$MW_{(net)}$ output attainable when operating on syngas. This is due, in part, to the lack of nitrogen that would otherwise be available for nitrogen dilution and power augmentation when operating the ASU to supply oxygen to the gasifiers.

As noted in Section 2.3, Minnesota's Iron Range is served by GLG and NNG. The GLG natural gas pipeline transmission system interconnects with NNG's natural gas pipeline system near Carlton, Minnesota. Figures 2.3.1, and 2.3.2 show the location of the natural gas transmission pipelines north of Carlton and near the West Range Site. NNG's natural gas pipeline to the East Range Site is shown in Figure 2.6.20.

If the West Range Site is approved by the MPUC, natural gas may be supplied through a direct connection with the GLG pipeline located about 12 miles due south of the IGCC Power Station, or from NNG's tapping point located in La Prairie, Minnesota, about 10 miles west southwest of the Station. This access to multiple pipeline infrastructure alternatives is beneficial. The Applicant will contract with either or both entities for natural gas transportation capacity and for quantities and at pressures sufficient to operate the Power Station at its limited capability (see above paragraph) when firing its backup fuel.

As noted in Section 2.6.4, the East Range Site has only one natural gas supply option, the NNG Pipeline. An existing branch pipeline (known as the Erie Branch line) from NNG's main pipeline originating at a tap of the GLG's pipeline in Carlton, Minnesota, directly abuts the eastern boundary of the Buffer Land. Twenty-seven (27) miles of "looped" 16" pipe (that is, new pipeline laid within the ROW of an existing pipeline, in this case the 10" Erie Branch pipeline) and a 2,500 horsepower compressor expansion is required to provide natural gas to the East Range Site in sufficient quantity and pressure to operate the Power Station at its limited capability when firing its backup fuel. Only limited easements are required to access the pipeline ROW. The Applicant would contract with NNG to provide gas transportation and other entities to supply natural gas.

The Applicant will purchase natural gas through a series of contracts with gas suppliers in order to obtain the lowest overall fuel price and best contract conditions for this commodity. Due to the volumes of natural gas required to fuel the IGCC Power Station, the Applicant will install and operate accurate metering equipment to confirm the extent of such purchases. Typical natural gas composition is shown in Table 3.3-2.

Table 3.3-2 Typical Natural Gas Constituents

Constituent	Percent By Volume
Methane	96.9
Ethane	2.00
Propane	0.50
n-Butane	0.10
i-Butane	0.10
n-Pentane	0.00
i-Pentane	0.00
Hexane+	0.10
Oxygen	0.00

Constituent	Percent By Volume
Carbon dioxide	0.00
Nitrogen	0.30
TOTAL	**100.00**
Sulfur, ppmv	14.8
Specific Gravity (air = 1.00)	0.57-58
Net Heating Value (Btu per scf)	935
Btu = British thermal units. scf = standard cubic feet.	

3.3.4 Water Supply

Water is needed by Mesaba One and Mesaba Two in significant quantities for the steam cycle, cooling, and introducing fuel into the gasifier. Water supplies for the West Range and East Range Power Stations will come from different sources and be required in slightly different quantities. The sources and quantities of water required at each site are discussed in detail in Section 3.6.1. Section 3.6.1 confirms that the water supply sources for each Site are sufficient to provide the quantities of water required by Mesaba One and Mesaba Two for the specific uses outlined in the subsections below.

3.3.4.1 Steam Cycle

Raw water must be treated to ultra purity standards to be used in the heat recovery steam generators ("HRSG") for steam production. The steam produced in the HRSGs is delivered to the steam turbine and condensed for reuse.

3.3.4.2 Non-Contact Cooling (Cooling Tower Operation)[8]

Heat must be rejected from the IGCC Power Station's condenser in order to maintain proper steam cycle characteristics. Large volumes of water are required for this purpose (a typical 600 MW pulverized coal-fueled power plant would require about 300,000 gallons of water per minute for a once-through cooling system). The IGCC Power Station will use cooling towers to reduce – relative to a once-through cooling system – the amount of water required to be withdrawn from the Water Resources. In a cooling tower, warmed cooling water from the Power Station's condenser is cooled by the evaporation of a portion of the water as it passes through the cooling tower. In addition to evaporation, a very small amount of entrained water, called drift (water droplets that are entrained in the exhaust air stream carrying heat away from the towers), will also be emitted into the atmosphere. As evaporation continues, salts dissolved in the remaining cooling liquid become more concentrated. When the concentrations of dissolved salts near their solubility limit, scale formation may occur on the condenser tubes and hinder heat transfer. Although addition of certain chemicals can inhibit scale formation, a portion of the cooling water, called blowdown, must be removed from the system and discharged.

[8] Black & Veatch, 1996, "Power Plant Engineering," Page 525-26.

Discharges of cooling tower blowdown will be authorized under terms of an NPDES permit to be issued by the MPCA. The amount of cooling tower blowdown generated, its characteristics, and how its discharge is managed is discussed in Section 3.4.2.

3.3.4.3 Contact Cooling

Water is used in numerous enclosed towers to cool and clean the syngas. This is generally accomplished by routing the syngas through a countercurrent flow of water, with the syngas generally being introduced into the bottom of a tower and water at the top. The water, by virtue of its physical contact with the contaminated syngas, absorbs soluble contaminants, becomes contaminated itself, and thereafter is treated. In Mesaba One and Mesaba Two, such contact process waters will be segregated from cooling tower blowdown and routed through a ZLD system, thereby ensuring that no trace elements carried over from the coal feedstock will be discharged to ambient receiving waters. Systems included in the sour water treatment process will remove mercury from this wastewater stream prior to sending it through the brine concentrator and ZLD system. The ZLD system is discussed in further detail in Sections 3.1.6.3, 3.4.2.1.2, 3.4.3.1.7, 3.4.4.1.3, and 3.6.1.2.

3.3.4.4 Feedstock Slurry and Source of Hydrogen

Water serves a critical role in the IGCC Power Station, both as a slurrying agent for introducing feedstocks into the gasifier and as a source of hydrogen to enhance the reducing atmosphere inside the gasifiers.

3.4 PROJECT DISCHARGES AND PRODUCTS

3.4.1 Air Pollutants

Discharges of air emissions will meet all required State and Federal standards, with analysis demonstrating that emission levels are largely independent of the specific Site. The block flow diagrams presented in Figure 3.1-1 and Figure 3.1-2 enumerate air emission sources and their associated control equipment. The spatial location of the major air emission points on the IGCC Power Station are identified on the layout plan in Figure 3.2-1. Maximum and average emission quantities from each point have been estimated using:

- Equipment supplier data
- BACT as proposed in the Part 70/New Source Review Construction Authorization permit application
- Test results for similar equipment at other IGCC facilities, especially the existing Wabash River (which also uses E-Gas gasification technology)
- Engineering calculations, experience, and judgment
- Published and accepted average emission factors, such as the U.S. EPA Compilation of Air Pollutant Emission Factors (AP-42)

The following sections describe these estimates and the calculation basis for both criteria and non-criteria pollutants. Detailed calculation descriptions and examples are presented in the West Range IGCC Power Station application for a Part 70/New Source Review Construction Authorization attached as Appendix 5. With the exception of PM_{10} emitted from the cooling towers, the calculations are independent of the Site and, therefore, can be applied to the East Range IGCC Power Station (PM10 emissions from the cooling towers are increased at the East Range IGCC Power Station due to higher concentrations of total dissolved solids in the mine pit waters).

3.4.1.1 Criteria Pollutants

Table 3.4-1 presents the normal and maximum short-term emission rates for each source. Table 3.4-2 shows the proposed maximum annual criteria pollutant emission rates for each emission source in the facility.

Table 3.4-1 Short-Term Emission Summary (Phase I plus Phase II)

Emission Source	Normal Emission Rate (lb/hr)[1]					Maximum Emission Rate (lb/hr)[1]				
	NOx	SO_2	CO	PM10[2]	VOC	NOx	SO_2	CO	PM10[2]	VOC
Combustion Turbines	624	270	380	100	35	792	732	10,960[3]	100	1,052[3]
Tank Vent Boilers	12	7.2	3.6	0.4	0.2	39	17	12	1.4	0.6
Flares[4]	0.3	negl[5]	2.2	negl	negl	478	2,080	11,400	60	45
Auxiliary Boilers	9.4	0.8	19	1.3	1	9.4	0.74	19	1.3	1
Cooling Towers				9/58					9/58	
Fugitive PM10				8.6					8.6	
Fugitive VOC					3.8					3.8
Emergency Generators	158	4.2	36	5.8	6.2	158	4.2	36	5.8	6.2
Emergency Fire Water Pump Engines	37	2.5	8.0	2.6	3.0	37	2.5	8.0	2.6	3.0
Total	**841**	**285**	**449**	**128[6]/177[7]**	**49**	**1,513**	**2,836**	**22,435**	**189[6]/238[7]**	**1,112**

[1]See following text for description of normal and maximum short-term emissions.
[2]PM10 includes filterable plus condensable fractions.
[3]Peak startup emission rate for four CTGs; normally startup for these engines will not occur simultaneously.
[4]Normal flare emission rates are for natural gas pilots only.
[5] negl = negligible emissions.
[6] West Range IGCC Power Station
[7] East Range IGCC Power Station

Table 3.4-2 Annual Emission Summary (Phase I and II)

Emission Source	Emission Rate (ton/year)				
	NOx	SO_2	CO	PM10	VOC
Combustion Turbines	2,772	1,332	1,928	440	176
Tank Vent Boilers	53	32	16	1.8	0.8
Flares	27	25	572	3.4	2.6
Auxiliary Boilers	10	0.8	21	1.4	1.1
Cooling Towers				39[1]/255[2]	
Fugitive PM10				6.7	
Fugitive VOC					17
Emergency Generators	7.9	0.20	1.8	0.29	0.31
Emergency Fire Water Pump Engines	1.9	0.12	0.40	0.13	0.15
Total	**2,872**	**1,390**	**2,539**	**493[1]/709[2]**	**197**

[1]West Range IGCC Power Station
[2]East Range IGCC Power Station
See text in Sections 3.4.1.1.1 through 3.4.1.1.8 for explanation of annual emission basis.

3.4.1.1.1 Combustion Turbine Generators

Emissions from the IGCC Power Station are primarily controlled through the inherently lower polluting IGCC coal gasification technology. Specifically, the production of syngas at relatively high pressure allows efficient and cost-effective syngas cleanup prior to combustion in the CTGs to produce electricity. As discussed in the preceding process description in Section 3.1, the following treatment steps will be applied to the syngas:

- Hot gas particulate matter filtration via cyclone and ceramic filter to achieve more than 99.9% particulate matter removal
- Water scrubbing to remove soluble contaminants, condensable materials, and suspended particulate matter
- Amine treatment combined with COS hydrolysis
- Carbon absorption for removal of mercury and other trace contaminants
- Moisturization (water saturation) for NO_X control and improved power production

In addition to the syngas treatment measures discussed above, the moisturized product syngas fuel is diluted by about 100 percent (one-to-one) with ASU nitrogen for additional NO_x reduction. Steam injection, in lieu of nitrogen dilution and moisturization, will be used for NO_x control when operating on natural gas. Finally, each CTG will be equipped with inlet air filters to minimize particulate matter emissions potentially caused by advection of suspended atmospheric materials contained in the combustion air.

Emissions from the CTGs are based on the following gas concentrations as emitted at the HRSG stack (or, in the case of particulate matter, the stack emission rate):

Syngas

- SO_2, based on 50 ppmvd, as H_2S in the undiluted syngas, rolling 30-day average and assuming 100% conversion of H_2S to SO_2
- NOx, 15 ppmvd (@ 15% O_2)
- CO, 15 ppmvd (@ 15% O_2)
- PM10, 25 lb/hr/CTG
- VOC, 2.4 ppmvd (@15% O_2)

Natural Gas

- SO_2, pipeline-quality natural gas (assumed 1.0 grain/100 scf total sulfur) and assuming 100% conversion of sulfur to SO_2
- NOx, 25 ppmvd (@ 15% O_2)
- Other criteria pollutants, equal to or less than syngas emission rates

As is the case with many types of internal combustion engines, CTG emissions of one or more pollutants during startup can exceed the normal operating emission rates for short periods. This temporary higher emission rate is caused by reduced combustion efficiencies during initial operation at low temperatures and low loads, as well as the delay necessary to achieve minimum specified combustor conditions prior to commencement of steam injection for NO_X control.

Table 3.4-3 shows the maximum short-term CTG emission rates for the four major operating conditions. The emission rates shown in this table reflect the maximum values for available commercial CTGs.

Table 3.4-3 Maximum CTG Short-Term Emission Rates (Phase I and II)

Operating Mode	Emission Rate (lb/hr)				
	NO_X	SO_2	CO	PM_{10}	VOC
Normal syngas operation[1]	624	270	380	100	35
Maximum syngas operation[2]	624	732	380	100	35
Maximum natural gas operation	792	24	288	72	26
Worst-case startup[3]	484	<24	10,960	44	1052

[1]30-day rolling average fuel sulfur.
[2]Peak 1-hour average fuel sulfur.
[3]Worst-case startup for four CTGs; normally all four would not start up simultaneously.

The maximum annual CTG emission rates and basis are summarized in Table 3.4-4 and Table 3.4-5 for the first four years of operation and years 5-30, respectively.

Table 3.4-4 Maximum CTG Annual Emissions Years 1 – 4 (Phase I and II)

	Yr. No. 1 TPY	Yr. No. 2 TPY	Yr. No. 3 TPY	Yr. No. 4 TPY	Basis[1]
Hrs/Yr	2630	1750	880	440	Peak natural gas per year
NOx	2954	2880	2807	2770	Balance of year on syngas at full load
SO_2	964	1088	1210	1271	Balance of year on syngas at full load, 50 ppmvd annual average sulfur in fuel
CO	1808	1848	1888	1909	Plus 50 hr/yr startup/shutdown per CTG, balance of year on syngas at full load
PM10	401	414	426	432	Balance of year on syngas at full load
VOC	167	171	174	176	Plus 50 hr/yr startup/shutdown per CTG, balance of year on syngas at full load

[1] Indicated hours of natural gas full load operation plus additional operation described for each pollutant.

Table 3.4-5 Maximum CTG Annual Emissions Years 5 – 30 (Phase I and II)

	Tons/Year	Basis
NOx	2,772	440 hours (approx 5% of the year) on full-load natural gas operation; 8,320 hours on full load syngas operation.
SO_2	1,332	Full year (8,760 hours) on full-load syngas operation; 50 ppmvd average H_2S in undiluted syngas
CO	1,928	50 hours startup/shutdown per CTG, balance of year (8,710 hours per CTG) on full-load syngas operation
PM_{10}	440	Full year (8,760 hours) on full load syngas operation
VOC	176	50 hours startup/shutdown per CTG, balance of year (8, 710 hours per CTG) on full load syngas operation

3.4.1.1.2 Tank Vent Boilers

The tank vent boilers (TVBs, one for each phase) will be designed to safely and efficiently dispose of recovered process vapors from various process tanks and vessels associated with the gasification process. The TVBs prevent the emission of reduced sulfur compounds and other gaseous constituents to the atmosphere that could cause nuisance odors and other undesirable environmental consequences. The TVBs may also be operated on natural gas to produce steam for the IGCC Power Station during gasifier shutdowns. The estimated maximum short-term and annual emission rates, based on supplier estimates for similar equipment, are shown in Table 3.4-6 and Table 3.4-7.

Table 3.4-6 Tank Vent Boiler Short-Term Emissions (Phase I and II)

Operating Mode	Emission Rate (lb/hr)				
	NOX	SO_2	CO	PM10	VOC
Normal syngas operation[1]	9	7	2.6	0.3	0.1
Maximum syngas operation[2]	39	17	12	1.4	0.6
Maximum natural gas operation[3]	24	0.2	7.2	0.8	0.3

[1]Assumes 30 MMBtu/hour heat input rate.
[2]Assumes 130 MMBtu/hour heat input rate.
[3]Assumes 80 MMBtu/hour heat input rate.

Table 3.4-7 Maximum Tank Vent Boiler Annual Emissions (Phase I and II)

	Tons/Year
NOx	53
SO_2	32
CO	16
PM10	1.8
VOC	0.8

[1]Based on approximately 280 trillion (10^{12}) Btu/yr, syngas plus tank vent vapors, and about 37 trillion Btu/yr natural gas combusted. Assumed sulfur in tank vapors averages 1.5 lb/hr (each phase) on annual basis.

3.4.1.1.3 Flares

The elevated flares for Mesaba One and Mesaba Two will be designed for a minimum 99 percent destruction efficiency for carbon monoxide and hydrogen sulfide. As discussed previously, the flares are normally used only to oxidize treated syngas and natural gas combustion products during gasifier startup operations. The flares will also be available to safely dispose of emergency releases from the IGCC Power Station during unplanned upset events or outages.

The estimated maximum short-term and annual emission rates, based on agency guidance and equipment supplier specifications, are shown in Table 3.4-8.

Table 3.4-8 Flare Short-Term Emission Rates (Phase I and II)

Operating Mode	Emission Rate (Lb/Hr)				
	NO_X	SO_2	CO	PM_{10}	VOC
Normal operation[1]	0.3	0.01	2.2	0.03	0.02
Normal startup operation[2]	230	370	5,350	28	21
Maximum flaring operation[3]	478	2,080	11,360	60	45
	Emission Rate (Tons/Year)				
Maximum Annual[4]	26.8	24.6	572	3.4	2.6

[1]Natural gas pilot, only.
[2]Startup flaring of syngas for two gasifiers and two flares.
[3]Maximum flaring capacity for two flares, based on flaring syngas production from two gasifiers for each flare and a worst case upset sulfur content of 400 ppmv in syngas.
[4]Maximum annual emission based on combustion of approximately 700 billion Btu of syngas and 136 billion Btu of natural gas during startup, plant upsets, and normal operating conditions.

3.4.1.1.4 Fugitive Equipment Leaks

VOC and HAPs emissions associated with normal equipment leakage have been estimated using proscribed U.S. EPA fugitive emissions factors for valve seals, pump and compressor seals, pressure relief valves, flanges, and similar equipment. For the case of VOC, only the amine handling system is included in the estimate since methyl diethanolamine (MDEA) would be the only VOC handled in significant quantity at the facility. Fugitive emission estimates of HAPs are based on the estimated concentration of each HAP in various syngas streams multiplied by the calculated leakage rates. The estimated fugitive emissions are summarized in Table 3.4-9.

Table 3.4-9 Fugitive Emission Estimate (Phase I and II)

Emission Type	Emission Rate	
	lb/hr	Ton/Yr
Federal HAPs	0.06	0.3
Ammonia	0.2	1.3
Hydrogen sulfide	4.0	17
MDEA	3.2	14
VOC	3.8	16
TRS	4.0	17

[1]Volatile organic compounds (VOC) include MDEA, benzene, carbon disulfide, carbonyl sulfide, ethyl benzene, hexane, hydrogen cyanide, naphthalene, toluene, xylenes, and waste oil.
[2]Total reduced sulfur (TRS) includes carbon disulfide, carbonyl sulfide, and hydrogen sulfide.

3.4.1.1.5 Material Handling Systems

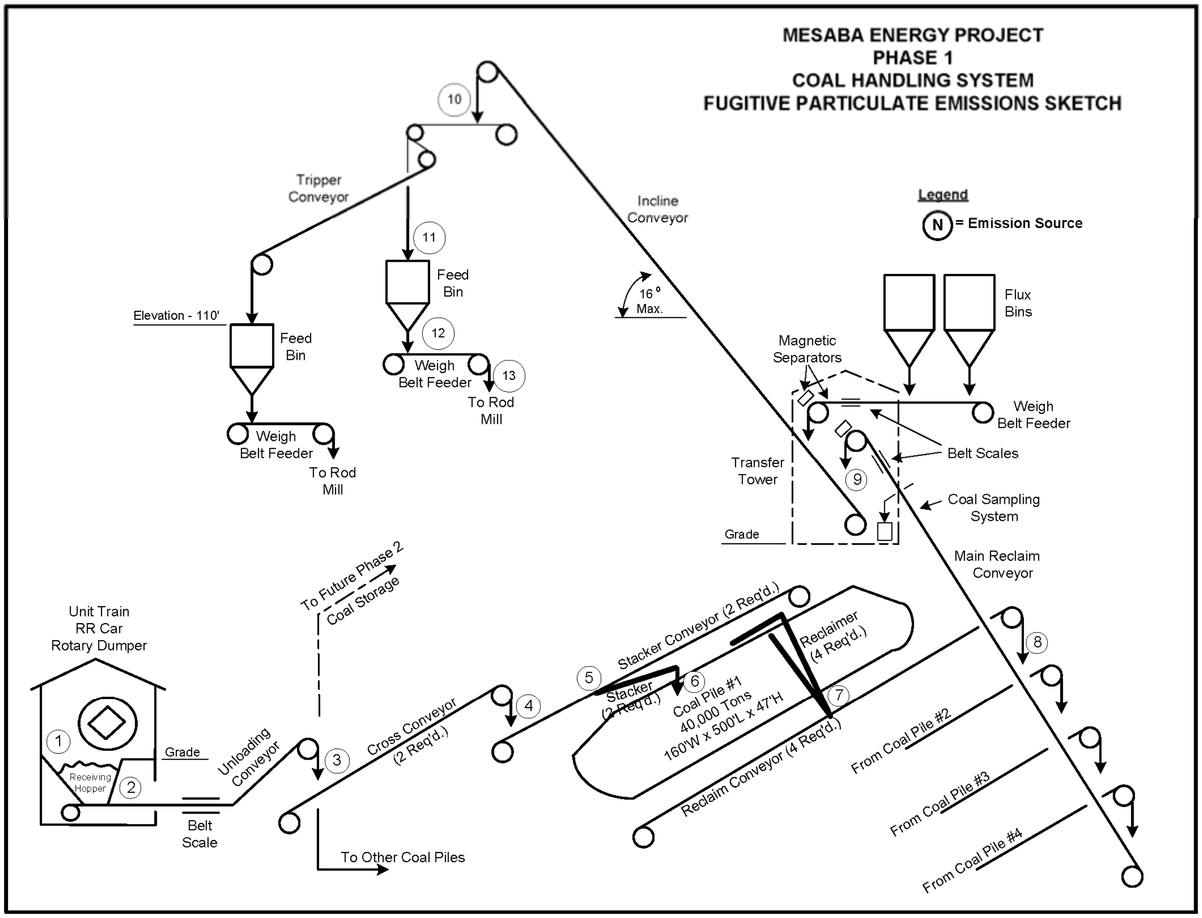
Fugitive particulate matter emissions (fugitive dust) will be generated by coal/coke and slag handling, preparation, and storage during the operational phase of the IGCC Power Station. Sources of these emissions include the active and inactive coal/coke storage piles, conveyors/transfer points, slurry preparation area, and the slag storage area. Estimated emissions of total suspended particulate matter (particulate matter with an aerodynamic diameter no greater than 30 microns) and PM_{10} (particulate matter with an aerodynamic diameter no greater than 10 microns) for these sources are summarized in Table 3.4-10 for Phase I operations (fugitive particulate matter emission rates for Phase I plus Phase II would be twice the values shown). Detailed calculations are presented in Appendix 5 (the West Range IGCC Power Station application for a Part 70/New Source Review Construction Authorization Permit); material handling emission calculations are independent of the Site and, therefore, can be applied to the East Range IGCC Power Station.

The estimates of particulate matter emission rates (lb/hr, tons/year) are based on methodologies developed by the U.S. EPA and documented in AP-42 ("Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources," 5th Edition). Specific portions of AP-42 utilized in the current analysis include Section 13.2.4 ("Aggregate Handling and Storage Piles"), Section 13.2.5 ("Industrial Wind Erosion"), and Section 13.2.2 ("Unpaved Roads"). These sections were used to estimate emission factors for the various coal/slag handling and moving components, windage losses from the coal and slag piles, and emissions resulting from on-site truck traffic movement of slag from process units to the slag storage pile.

The emission factor for rail car unloading of feedstock was developed from Electric Power Research Institute (EPRI) report CS-3455, published in June 1984. The peak hourly throughput for this system, as well as for conveyors and transfer points up to the storage pile, is based on unloading approximately 36 unit train cars per hour (approximately 4,300 tons/hr). Figure 3.4-1 shows a sketch of the proposed feedstock handling system.

The emission factors (expressed in lb/ton) for aggregate handling systems derived from AP-42 are multiplied by the maximum material throughput to estimate an uncontrolled particulate matter emission rate. Peak values are expressed on an hourly basis and represent the maximum system throughput requirements. For the materials handling facilities upstream of the coal pile, this rate is as described above. For materials handling facilities downstream of the storage pile, the peak rate is based on 120 percent of the average rate required for the nominal plant output. The annual throughput is based on the average material throughput requirement for the plant at full load conditions based on 8,760 hours per year. The AP-42 methodology correlates the aggregate handling particulate matter emission factor inversely with coal moisture content. Because of this, the maximum plant fugitive particulate matter emission rates were found to be higher on operation with Illinois No. 6 coal versus the significantly higher moisture content (and higher as-received throughput rate) for PRB-1 coal. The maximum slag generation and throughput rates are also based on operation with Illinois No. 6 coal. The slightly higher slag generation rate based on operation with a blended coal had an insignificant impact on the emissions from the slag handling systems. However, in practice, PRB coal is known to be dusty. To account for this experience and to derive more conservative "worst case" estimates, the surface moisture content in PRB coal was assumed to be 4% and the fugitive particulate matter emission rates were recalculated. The fugitive emissions from PRB coal using the revised assumptions are provided in Table 3.4-10.

Figure 3.4-1 Sketch of Proposed Feedstock Handling System



Uncontrolled particulate matter emissions estimates were modified as appropriate by a control efficiency multiplier. Control efficiencies used in these estimates include:

1.	No control method	0%
2.	Railcar/Feedstock storage pile load-in	50%
3.	Partial enclosure of transfer point	70%
3a.	Partial enclosure w/dust suppression spray	75%
4.	Full enclosure of transfer point	90%
4a.	Full enclosure w/dust suppression spray	95%
4b.	Full enclosure with baghouse filter	99%
5.	Roadway w/watering and cleaning	80%

The control efficiency for railcar unloading and storage pile load-in using an adjustable stacker are based on engineering judgment for the partial containment systems planned. References to items 3 and 4 above are identified in EPA 450/3-81-005b (Sept. 1982) and Environmental

Progress (Feb. 1984). The control efficiencies for items 3a, 4a, and 4b are based on engineering judgment and preliminary discussions with dust suppression system vendors (to assess enhanced particulate matter suppression and/or capture using the systems identified relative to the control efficiency for an enclosed system alone). The reference for the control efficiency provided for item 5 is found in AP-42 (Section 13.2.2).

The wet spray dust suppression systems require that water be supplied to the various injection points. This water may be blended with glycol for freeze point suppression, and/or surfactants (wetting agents) or chemical binding or encrusting agents. Because of such chemical additions, any free water draining from the solids will be captured and treated as required before re-use on-site or off-site disposal.

Determination of particulate matter emissions resulting from wind erosion of the storage piles requires information on pile geometry and wind velocities at the plant site. As shown on the IGCC Power Station plot plan and visual renderings (see Figure 3.2-1 and Figure 3.2-2), oval storage piles have been assumed. Lengths, widths, angles of repose and heights have been determined to provide the required storage volumes in one or more piles. These values were used to estimate the pile surface areas exposed to winds, as required by the AP-42 procedure. Historical wind velocity profiles (speed and annual frequency of occurrence) were obtained from University of Minnesota Technical Bulletin AD-TB1955 for the local Hibbing, Minnesota area. The reported wind velocities are relatively low, and only infrequently exceed the threshold friction velocity needed to generate quantifiable emissions as defined by the AP-42 procedure. Hence, at these conditions, the piles were not significant contributors to overall plant particulate matter emissions.

In-plant trucks will be used to transport dewatered, by-product slag from the gasifier slag handling area to the slag storage pile or bins to await shipment by rail or truck to offsite locations. A truck traffic emission factor from AP-42 is used to estimate fugitive road dust from this internal slag transfer operation. A control efficiency of 80 percent has been applied to this emission source based on watering of the roadway near the pile to suppress dust and periodic removal/cleanup of dust-producing material.

Table 3.4-10 Fugitive Particulate Matter Emission Estimate (Phase I Operation)

Emission Source Description		Notes	PM30 Emission Factor (lb/ton)	PM10 Emission Factor (lb/ton)	Maximum Hourly Throughput (ton/hr)	Maximum Annual Throughput (ton/yr)	Control Method	Control Efficiency (%)	Controlled PM30 Maximum Hourly Emission Rate (lb/hr)	ControlledP M30 Maximum Annual Emission Rate (ton/yr)	Controlled PM10 Maximum Hourly Emission Rate (lb/hr)	Controlled PM10 Maximum Annual Emission Rate (ton/yr)
COAL HANDLING AND STORAGE												
1	Railcar Unloading	1,9	0.00174	0.00087	4,300	3,100,000	Partially Enclosed Shed with dust suppression sprays	75	1.871	0.674	0.935	0.337
2	Unloading hopper to Unloading Conveyor	2,9	0.0020	0.0010	4,300	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.432	0.156	0.204	0.074
3	Unloading conveyor to Cross-Conveyor	2,9	0.0020	0.0010	4,300	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.432	0.156	0.204	0.074
4	Cross-Conveyor to Stacker Conveyor	2,9	0.0020	0.0010	4,300	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.432	0.156	0.204	0.074
5	Stacker Conveyor to Stacker	2,9	0.0020	0.0010	4,300	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.432	0.156	0.204	0.074
6	Stacker to Coal Pile	2,9	0.0020	0.0010	4,300	3,100,000	Ring-type dust suppression sprays at discharge point; Adjustable height stacker	50	4.323	1.558	2.044	0.737
7	Reclaimer to Reclaim Conveyor	2,8	0.0020	0.0010	430	3,100,000	Partially Enclosed transfer point with dust suppression sprays	75	0.216	0.779	0.102	0.368
8	Reclaim Conveyor to Main Conveyor	2,8	0.0020	0.0010	430	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.043	0.156	0.020	0.074
9	Main Conveyor to Incline Conveyor	2,8	0.0020	0.0010	430	3,100,000	Fully enclosed transfer point with dust suppression sprays inside building	95	0.043	0.156	0.020	0.074
10	Incline Conveyor to Tripper Conveyor	2,8	0.0020	0.0010	430	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.043	0.156	0.020	0.074

Emission Source Description		Notes	PM30 Emission Factor (lb/ton)	PM10 Emission Factor (lb/ton)	Maximum Hourly Throughput (ton/hr)	Maximum Annual Throughput (ton/yr)	Control Method	Control Efficiency (%)	Controlled PM30 Maximum Hourly Emission Rate (lb/hr)	ControlledPM30 Maximum Annual Emission Rate (ton/yr)	Controlled PM10 Maximum Hourly Emission Rate (lb/hr)	Controlled PM10 Maximum Annual Emission Rate (ton/yr)
11	Tripper Conveyor to Feed Bin	2,8	0.0020	0.0010	430	3,100,000	Fully enclosed transfer point with baghouse dust collector	99	0.009	0.031	0.004	0.015
	Windage from Coal Storage	3,5	--	--	--	--	None	0	--	0.104	--	0.052
	SUBTOTAL								**8.28**	**4.24**	**3.97**	**2.02**
COAL SLURRY FACILITY SOURCES												
12	Feed Bin to Weigh Belt Feeder	2,8	0.0020	0.0010	430	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.043	0.156	0.020	0.074
13	Weigh Belt Feeder to Rod Mill Feed Chute	2,8	0.0020	0.0010	430	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.043	0.156	0.020	0.074
	SUBTOTAL								**0.09**	**0.31**	**0.04**	**0.15**
SLAG TRANSPORT AND STORAGE												
	Slag Disposal Truck Traffic	4	8.5	2.26	0.40	3,500	Apply dust suppressant	80	0.680	2.975	0.181	0.791
	Slag Storage Load-in		Nil	Nil			Wet slag	100	0.000	0.000	0.000	0.000
	Windage from Slag Storage	3,6	--	--	--	--	None	0	--	0.027	--	0.013
	Slag Storage Load-out	7	0.0053	0.0025	39	281,780	None	0	0.207	0.748	0.098	0.354
	SUBTOTAL								**0.89**	**3.75**	**0.28**	**1.16**
	TOTAL								**9.25**	**8.30**	**4.28**	**3.33**

1. Emission Factor from EPRI CS-3455 (6/84).
2. Coal emission factors for transfer points from AP-42 Section 13.2.4); U=9.3 mph, M=4%; Emission factor E = k*0.0032*{(U/5)^1.3/(M/2)^1.4}; k=0.74 for PM and = 0.35 for PM10.
3. Windage emissions from AP-42 (Section 13.2.5); wind speeds from AD-TB1955 University of Minnesota "Climate of Minnesota".
4. Emission factor for onsite truck traffic (slag transfer) from AP-42 (Section 13.2.2) in lb/VMT (vehicle miles traveled); Hourly throughput units are VMT per hour; assumed 0.2 mile/round trip between process units and slag pile; approximately 2 truck/hr required (20 ton truck); Approx 0.4 VMT/hr.
5. Coal active storage pile based on 4 oval piles, providing 20 day capacity (~ 160,000 tons for PRB-1).
6. Slag storage pile based on 1 oval pile, providing ~ 50 day capacity (~ 37,000 tons for bituminous coal or PRB2 – PRB3 blend).
7. Slag emission factors for transfer points from AP-42 Section 13.2.4); U=9.3 mph, M=2%; = k*0.0032*{(U/5)^1.3/(M/2)^1.4};k=0.74 (PM)/ = 0..35 (PM10).
8. Facilities between coal pile and slurry prep based on hourly throughput rate of 120% of average capacity at full plant output.
9. Maximum hourly feed rate based on unloading of thirty-six cars (119 tons per car) of unit train per hour; enables unloading of full unit train in about 3.2 hours.

3.4.1.1.6 Particulate Matter and Mercury Releases from Cooling Tower Drift

The high concentration of total dissolved solids (TDS) found in East Range pit waters is the source of increased PM10 emissions from the East Range cooling towers relative to such emissions from the West Range Site. TDS in pit waters on the East Range have been shown to be present at concentrations up to 1,800 mg/L, whereas peak concentrations of TDS in the West Range pits are on the order of 340 mg/L. The peak number of cycles of concentration expected at the West Range Site is eight, while East Range cooling towers are expected to operate up to a maximum of ten cycles of concentration.

Table 3.4-11 shows the expected maximum particulate matter emissions from the cooling towers as a result of drift. Alternate feedstock cases have shown slightly different conditions for the two cooling towers, which would affect the emissions rates somewhat. The emission estimates presented below are based on 100 percent PRB-1 coal feed to the plant, and the Siemens-Westinghouse turbine power block (606 MW net nominal plant output at the IGCC Power Station switchyard), and are indicative of the maximum combined particulate matter release. The drift rate is based on 0.001% of the tower recirculation rate as provided by equipment suppliers and reflects the use of high efficiency drift eliminators. The total dissolved solids (TDS) content of the drift is the maximum value estimated from water quality measurement data for the makeup water (the water quality data from which such maxima were derived are provided in the West Range NPDES Permit Application attached as Appendix 6 and in Appendix 7). Table 3.4-11 shows emissions from a single phase. The emissions for the combined Phase I and II operations would be double those shown.

Table 3.4-11
Particulate Matter (PM10) Emissions from Cooling Tower Drift (Per Phase)

	West Range		East Range	
	Power Block Cooling Tower	Gasification/ ASU Cooling Tower	Power Block Cooling Tower	Gasification/ ASU Cooling Tower
Duty (MMBtu/hr)	1,740	690	1,740	690
Recirculation Rate (10^6 lb/hr)	116	46	116	46
Drift (lb/hr)	1,160	460	1,160	460
TDS (ppmw)	2,720	2,720	18,000	18,000
PM10 Emission (lb/hr/tower)	3.2	1.3	21	8.3
PM10 Emission (lb/hr/cell)	0.3	0.3	1.7	1.7
PM10 Emission (TPY)	14	5.5	91	36

The Power Block cooling tower is currently configured with 12 cells, and the smaller Gasification/ASU cooling tower with 5 cells. Key performance data related to the cooling tower cells are presented in Table 3.4-12.

Table 3.4-12 Cooling Tower Characteristics (per cell)

Characteristic	Value
Exhaust Flow, 10^6 acfm (wet)	1.37
Exhaust Temperature, ^oF	104
Outlet Elevation (above grade), ft	48
Outlet Diameter, ft	33

The cycles of concentration in a cooling tower relate how much the dissolved solids are allowed to concentrate in the cooling water system. Assuming i) the Power Station is operating on eight cycles of concentration; ii) the total amount of water recirculated in the power block and gasification/ASU cooling towers is approximately 320,000 gallons per minute; iii) drift constitutes approximately 0.001% of the water being recirculated; iv) the plant operates at a 92% capacity factor year around; and v) the concentration of mercury in the raw make-up water is 0.9 nanograms per liter, releases of mercury via drift could be expected to be on the order of 0.04 grams per year per phase of the Project. At ten cycles of concentration, the amount of mercury released via drift would be 0.05 grams per year. Annual releases on this order are not considered to be environmentally consequential.

3.4.1.1.7 Auxiliary Boilers

The auxiliary boilers will normally operate only when no steam is available from the gasifiers or HRSGs. The annual capacity factor for these boilers will be 25% or less. The auxiliary boilers will be provided with low NOx burners for emission control. Emission rates based on supplier guarantees for similar equipment are shown in Table 3.4-13.

Table 3.4-13
Maximum Auxiliary Boiler Short-Term and Annual Emission Rates
(Phase I and II)

	lb/hr	Ton/Year*	Basis
NOx	9.4	10	Low NOx burner, 30 ppmvd (@ 3% O2)
SO2	0.74	0.82	1 grain/100 scf in pipeline gas
CO	19	21	100 ppmvd (@ 3% O2)
PM10	1.3	1.4	0.005 lb/million Btu, HHV
VOC	1.0	1.1	10 ppmvd (@ 3% O2)

*Annual emission based on 25% maximum annual capacity factor.

3.4.1.1.8 Emergency Diesel Engines

Other than the emergency uses for which they are intended, the diesel engines driving the emergency generators and fire protection pumps will be operated no more than 100 hours per year. Emissions for each engine are estimated using accepted agency-published factors (AP-42) and low sulfur diesel fuel. Table 3.4-14 shows the maximum short term and annual non-emergency emissions for each engine.

Table 3.4-14
Emergency Diesel Engines Emissions (Phase I and II)

Diesel Engine	Approx Capacity, Each	Total No. Of Engines - Phases I and II	Short-Term Emission (Lb/Hr)					Annual Emission (Ton/Yr)				
			NO_X	SO_2	CO	PM_{10}	VOC	NO_X	SO_2	CO	PM_{10}	VOC
Emergency generators – gasification island	2 MW	2	129	2	30	4	4	6.4	0.1	1.5	0.2	0.2
Emergency generators – power block	350 kW	2	29	2	6	2	2	1.5	0.1	0.3	0.1	0.1
Fire pumps	300 hp	4	37	2.5	8.0	2.6	3.0	1.9	0.1	0.4	0.1	0.1

3.4.1.2 Non-Criteria Pollutant Emissions and Lead

3.4.1.2.1 Lead Emissions

Plant emission rates for trace amounts of lead were estimated from published information for a similar IGCC facility.[9] These estimates are shown on Table 3.4-15 included in the hazardous air pollutants emission discussion below.

3.4.1.2.2 Sulfuric Acid Emissions

Sulfur trioxide (SO_3) emissions, expressed as sulfuric acid (H_2SO_4), for the CTGs and other plant emission sources were estimated based on supplier information and measurements at the Wabash River. These estimates are also shown on Table 3.4-15 in the hazardous air pollutants emission discussion below.

3.4.1.3 Hazardous Air Pollutant Emissions

Emission rates for hazardous air pollutants (HAPs), as identified by the Minnesota Pollution Control Agency, have been estimated for the Project using the following sources (listed in order of significance):

- Results of regulatory test programs at Wabash River - adjusted, as appropriate, for the expected worst-case feeds to the Mesaba Energy Project.
- Equipment supplier information.

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[9] NETL - National Energy Technology Laboratory, U.S. Dept of Energy, *Major Environmental Aspects of Gasification-based Power Generation Technologies, Final Report*, December 2002.

- Published emission factors and reports applicable to IGCC facilities.
- Engineering calculations and judgment.
- U.S. EPA emission factors (AP-42) for coal combustion.

HAP emissions at the IGCC Power Station will be reduced by the inherently low polluting IGCC technology and many of the same process features that control criteria emissions. A large portion of the heavy metals and other undesirable constituents of the feed will be immobilized in the non-hazardous vitreous slag by-product and thereby prevented from causing adverse environmental effects. Gaseous and particle-bound HAPs that may be contained in the raw syngas exiting the gasifiers will be totally or partially removed in the syngas particulate matter removal system, water scrubber, and AGR systems described above. In addition, the mercury removal carbon absorption beds will ensure that mercury emissions from the IGCC Power Station will be 10 percent or less of the mercury present in the feedstock as received.

Table 3.4-15 presents a summary of estimated HAPs emissions for the Phase I and Phase II IGCC Power Station. The West Range Site application for a Part 70/New Source Review Construction Authorization is attached as Appendix 5 and contains in an appendix the methodology used to estimate HAP emissions, shows example calculations, and identifies the sources of HAPs data used.

Table 3.4-15
Annual Hazardous Air Pollutant Emissions (Phase I and II)

CAS # or MPCA #	Compound	Annual Average HAP Emission (ton/yr)				Total Phase I	Phase I & Phase II
		CTGs	TVB	Flare	Fugitive		
75-07-0	Acetaldehyde	0.044	1.6E-04	3.9E-04		0.045	0.089
98-86-2	Acetophenone	0.022	7.9E-05	2.0E-04		0.022	0.045
107-02-8	Acrolein	0.43	1.5E-03	3.8E-03		0.43	0.87
7440-36-0	Antimony	0.027	2.8E-04	7.0E-04		0.028	0.056
7440-38-2	Arsenic	0.059	1.5E-03	3.7E-03		0.064	0.128
71-43-2	Benzene	0.061	0.028	0.071	0.0063	0.167	0.333
100-44-7	Benzyl chloride	1.03	3.7E-03	9.2E-03		1.0	2.1
7440-41-7	Beryllium	0.0064	7.9E-06	2.0E-05		0.0064	0.0128
92-52-4	Biphenyl	0.0025	9.0E-06	2.2E-05		0.0025	0.0051
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	0.11	3.9E-04	9.6E-04		0.109	0.218
75-25-2	Bromoform	0.06	2.0E-04	5.0E-04		0.057	0.114
7440-43-9	Cadmium	0.24	5.7E-05	1.4E-04		0.24	0.47
75-15-0	Carbon disulfide	1.13	4.0E-03	1.0E-02	0.034	1.18	2.35
463581	Carbonyl sulfide				0.058	0.058	0.116
532-27-4	Chloroacetophenone, 2-	0.0103	3.7E-05	9.2E-05		0.0104	0.0208
108-90-7	Chlorobenzene	0.032	1.1E-04	2.8E-04		0.032	0.065
67-66-3	Chloroform	0.088	3.2E-04	7.9E-04		0.089	0.179
0-00-5	Chromium, total (1)	0.013	1.1E-03	2.6E-03		0.016	0.033
18540-29-9	Chromium, (hexavalent)	0.0038	3.2E-04	7.9E-04		0.0049	0.0099
7440-48-4	Cobalt (1)	0.0064	1.2E-03	3.0E-03		0.011	0.021

CAS # or MPCA #	Compound	Annual Average HAP Emission (ton/yr)				Total Phase I	Phase I & Phase II
		CTGs	TVB	Flare	Fugitive		
98-82-8	Cumene	0.0078	2.6E-05	6.6E-05		0.0079	0.0159
57-12-5	Cyanide (Cyanide ion, Inorganic cyanides, Isocyanide)	0.140	4.6E-03	1.2E-02	0.0088	0.16	0.33
77-78-1	Dimethyl sulfate	0.071	2.5E-04	6.3E-04		0.072	0.144
121-14-2	Dinitrotoluene, 2,4-	4.2E-04	1.5E-06	3.7E-06		4.2E-04	8.4E-04
100-41-4	Ethyl benzene	0.14	0.032	0.079	5.4E-06	0.25	0.50
75-00-3	Ethyl chloride (Chloroethane)	0.061	2.2E-04	5.5E-04		0.062	0.124
106-93-4	Ethylene dibromide (Dibromoethane)	0.0018	6.3E-06	1.6E-05		0.0018	0.0036
107-06-2	Ethylene dichloride (1,2-Dichloroethane)	0.059	2.1E-04	5.3E-04		0.060	0.119
50-00-0	Formaldehyde	0.42	1.5E-03	3.7E-03	1.1E-06	0.42	0.84
110-54-3	Hexane	0.10	3.5E-04	8.8E-04	1.5E-06	0.10	0.20
7647-01-0	Hydrochloric acid	0.096	3.0E-04	7.4E-04	0.034	0.13	0.26
7664-39-3	Hydrogen fluoride (Hydrofluoric acid)	1.2	5.3E-05	1.3E-04		1.2	2.5
78-59-1	Isophorone	0.86	3.1E-03	7.6E-03		0.87	1.73
7439-92-1	Lead	0.014	6.3E-05	1.6E-04		0.014	0.028
7439-96-5	Manganese	0.025	2.4E-03	5.9E-03		0.034	0.068
7439-97-6	Mercury	0.012	6.6E-04	1.6E-03		0.015	0.029
74-83-9	Methyl bromide (Bromomethane)	1.23	0.011	0.029		1.3	2.5
74-87-3	Methyl chloride (Chloromethane)	0.78	6.0E-03	1.5E-02		0.80	1.61
71-55-6	Methyl chloroform (1,1,1 -Trichloroethane) (4)	0.029	1.1E-04	2.6E-04		0.030	0.060
78-93-3	Methyl ethyl ketone (2-Butanone)	0.58	2.1E-03	5.1E-03		0.58	1.17
60-34-4	Methyl hydrazine	0.25	9.0E-04	2.2E-03		0.25	0.51
80-62-6	Methyl methacrylate	0.029	1.1E-04	2.6E-04		0.030	0.060
1634-04-4	Methyl tert butyl ether	0.051	1.8E-04	4.6E-04		0.052	0.104
75-09-2	Methylene chloride (Dichloromethane)	0.056	5.5E-04	1.4E-03		0.058	0.117
91-20-3	Naphthalene	0.064	8.1E-04	2.0E-03	2.6E-05	0.067	0.133
7440-02-0	Nickel	0.0096	4.2E-03	1.0E-02		0.024	0.048
108-95-2	Phenol	0.95	1.2E-02	3.0E-02	7.8E-08	0.99	1.98
123-38-6	Proprionaldehyde	0.561	2.0E-03	5.0E-03		0.568	1.136
7784-49-2	Selenium	0.014	2.4E-04	5.9E-04		0.015	0.029
100-42-5	Styrene	0.037	1.3E-04	3.3E-04		0.037	0.075
127-18-4	Tetrachloroethylene (Perchloroethylene)	0.063	2.3E-04	5.7E-04		0.064	0.129

CAS # or MPCA #	Compound	Annual Average HAP Emission (ton/yr)				Total Phase I	Phase I & Phase II
		CTGs	TVB	Flare	Fugitive		
108-88-3	Toluene	0.00081	0.0112	0.0280	6.6E-04	0.041	0.081
108-05-4	Vinyl acetate	0.011	4.0E-05	1.0E-04		0.011	0.023
1330-20-7	Xylenes	0.055	0.013	0.032	1.0E-05	0.10	0.20
	Total federal HAPs	***11.4***	***0.2***	***0.4***	***0.1***	***12.0***	***24.1***
	Other Emissions						
56-55-3	Benz[a]anthracene	5.6E-05	2.0E-07	5.0E-07		5.7E-05	1.1E-04
207-08-9	Benzo(k)fluoranthene	1.6E-04	5.8E-07	1.4E-06		1.6E-04	3.3E-04
50-32-8	Benzo[a]pyrene	5.6E-05	2.0E-07	5.0E-07		5.7E-05	1.1E-04
218-01-9	Chrysene (Benzo(a)phenanthrene)	1.5E-04	5.3E-07	1.3E-06		1.5E-04	3.0E-04
193-39-5	Indeno(1,2,3-cd)pyrene	9.1E-05	3.2E-07	8.1E-07		9.2E-05	1.8E-04
3697-24-3	Methylchrysene, 5-	3.2E-05	1.1E-07	2.8E-07		3.2E-05	6.5E-05
7664-93-9 14808-79-8	Sulfuric acid and sulfates	62.0	0.2	0.6		62.8	125.6
	Other VOC				8.3	8.3	16.6
	Hydrogen sulfide				8.6	8.6	17.2
	Total Volatile Organic Compounds (VOC)	9.6	0.1	0.4	8.4	18.6	37.1
	Total Reduced Sulfur (TRS) Compounds	1.1	0.004	0.010	8.7	9.8	19.7

3.4.1.3.1 Mercury

The volume of pre-combustion syngas present at the time of its clean-up in the E-Gas™ process is about one hundred times less than the volume of the post-combustion gas handled in a typical conventional pulverized coal-fired boiler. An inherent advantage that IGCC technology has over such conventional systems is that gas clean up equipment can be much smaller in size and the residence time for allowing contact between a chemical (like mercury) and an absorbent (like activated carbon) can be increased, thereby providing for greater pollutant removal efficiency. This pre-combustion gas clean-up process allows for highly effective mercury removal rates, which in the case of Mesaba One and Mesaba Two will be at least 90 percent of the as-received combustion concentration present in its incoming fuel. For Mesaba One and Two, this translates to maximum annual mercury emissions of only 54 pounds on a twelve month rolling average. Figure 3.4-2 shows how mercury is expected to partition throughout the IGCC Power Station.

3.4.1.4 Carbon Dioxide

Carbon dioxide emissions from the IGCC Power Station are a function of the feedstock consumed and the Station's net heat rate (a measure of the overall efficiency under which the energy in the feedstock is converted to electricity). The characteristics of the feedstock that dictate the rate at which CO_2 is emitted are its carbon content and higher heating value. Figure 3.4-3 illustrates the rates at which CO_2 will be produced by Mesaba One and Mesaba Two when using 100% bituminous coal and 100% subbituminous coal as a feedstock. The CO_2 emission rates shown in Figure 3.4-3 do not account for any CO_2 removal that would occur as a result of the equipment additions described in Section 3.1.5.3.5. For purposes of comparison, the CO_2 generation rate of Sherco 3 (a pulverized coal-fired electric generating unit using western subbituminous coal) is also shown in Figure 3.4-3.

Emissions of CO_2 from other large coal-fired electric generating units in Minnesota are shown in comparison with Mesaba One and Mesaba Two in Figure 3.4-4. For those units shown in Figure 3.4-4 that use wet limestone scrubbers (for example Boswell Energy Center and Sherburne County Unites 1 and 2) CO_2 emissions will be underestimated as CO_2 is produced as a consequence of removing SO_2 from the combustion gases. For those units that use lime spray dryers to remove SO_2 from their combustion gases (for example, Sherburne County Unit 3), CO_2 is produced as a consequence of producing lime (CaO) from limestone ($CaCO_3$), some SO_2 will be removed by soluble oxides present in coal ash, thereby lowering the quantity of CO_2 produced as a result of reacting SO_2 and limestone slurry added for such reason.

Figure 3.4-2 Expected Mercury Partitioning in the IGCC Power Station (Mesaba One and Mesaba Two)

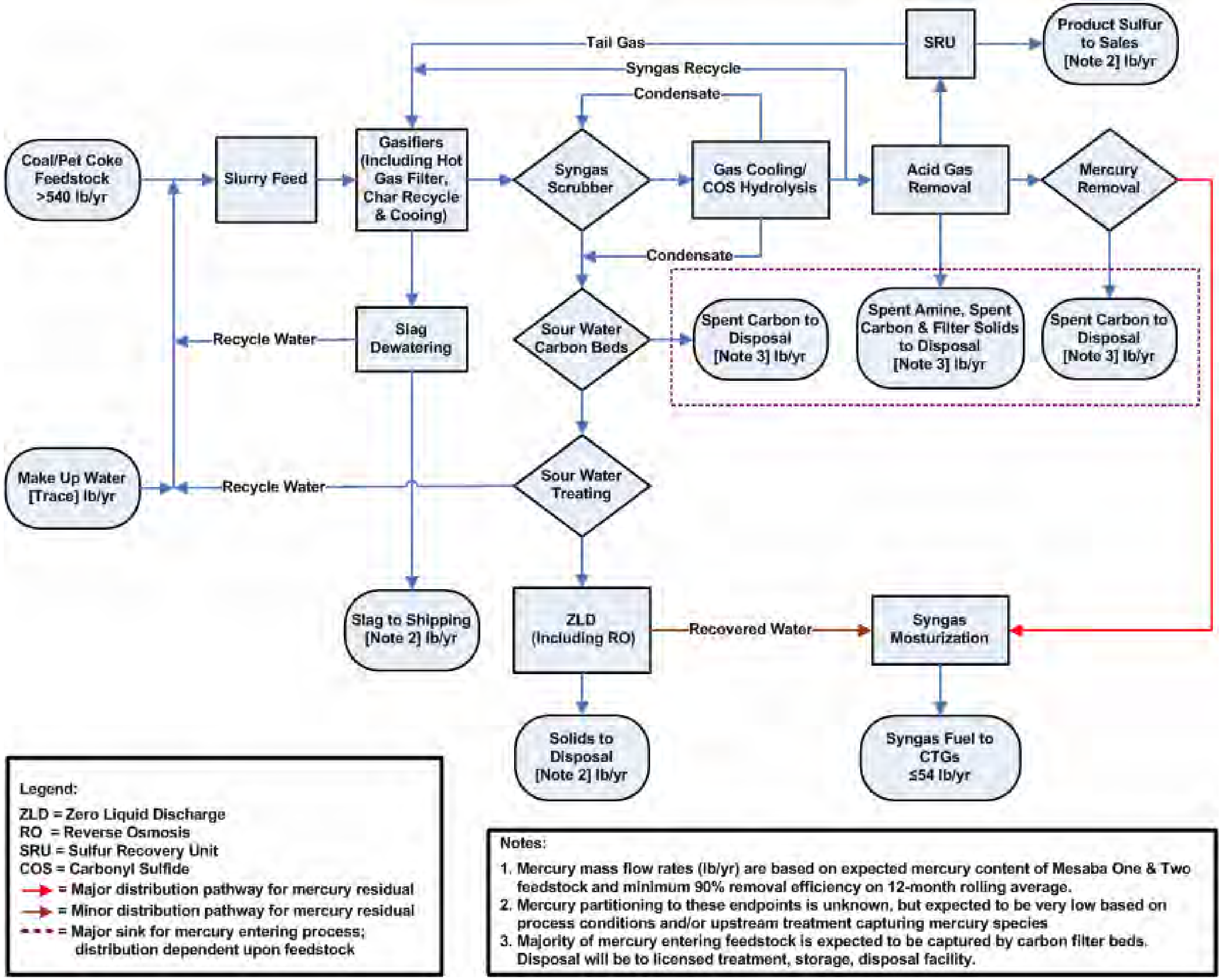


Figure 3.4-3 Carbon Dioxide Emissions From Mesaba Energy Project vs. Sherco Unit 3

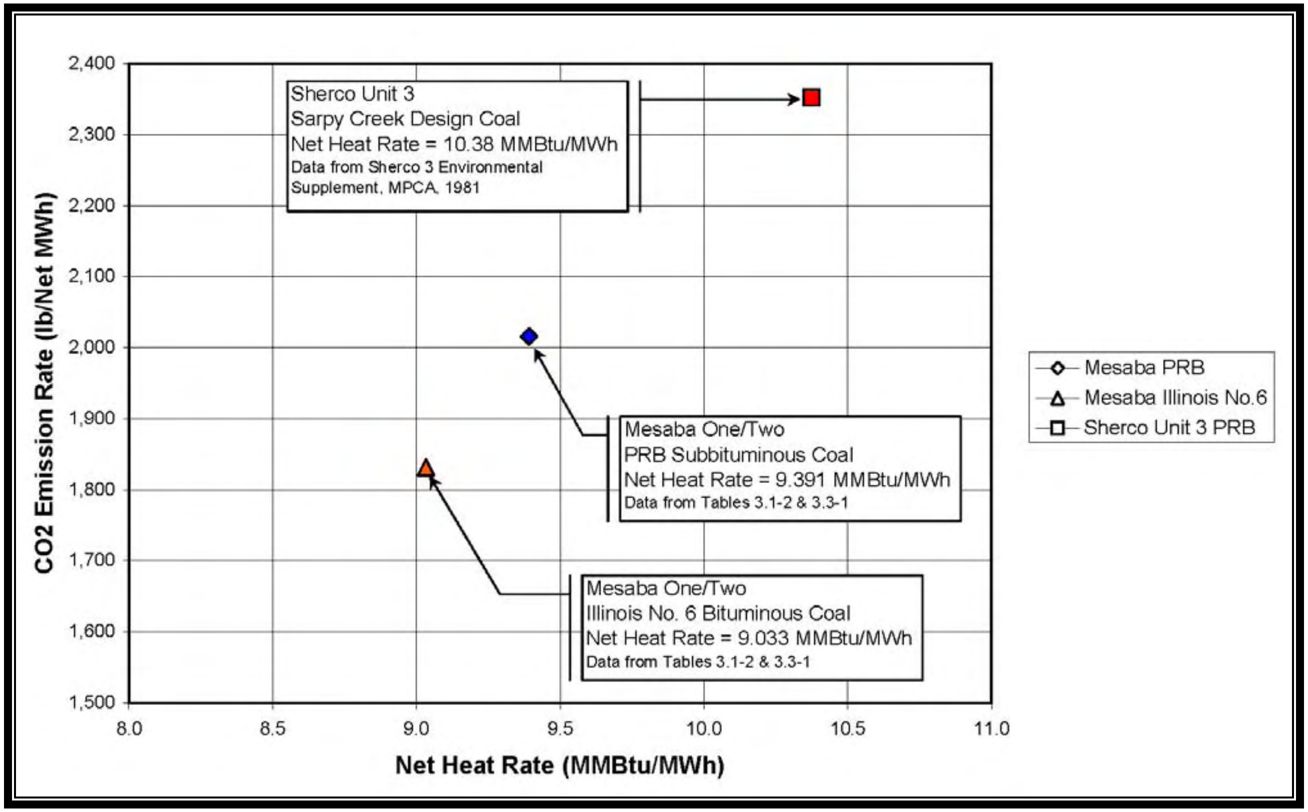
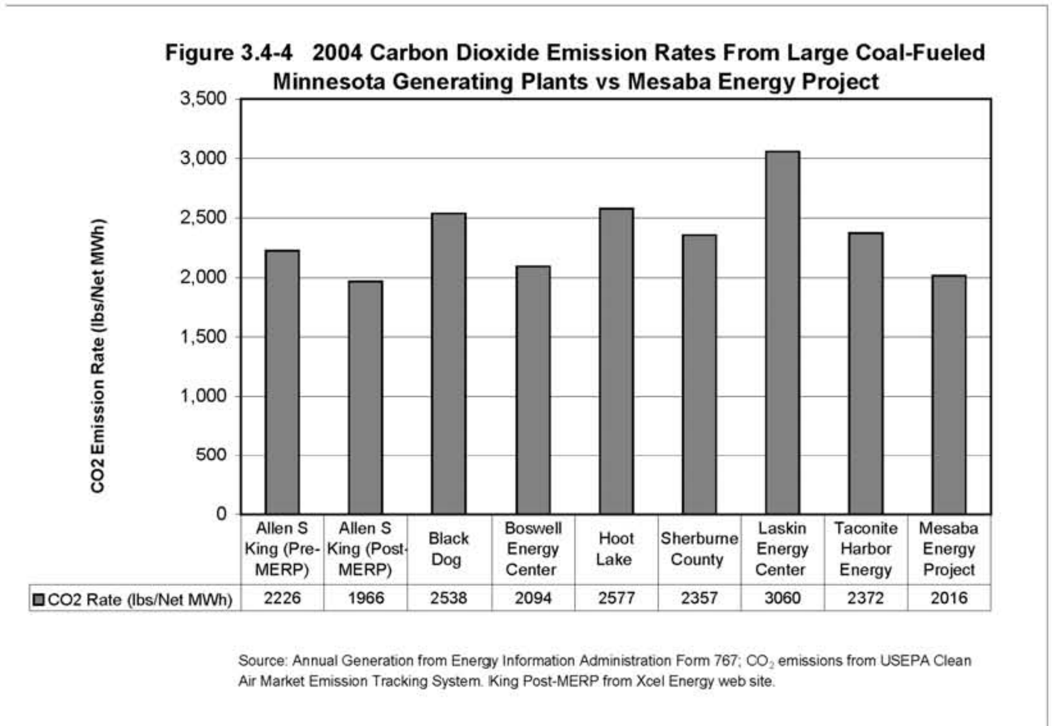


Figure 3.4-4 2004 Carbon Dioxide Emission Rates From Large Coal-Fueled Minnesota Generating Plants vs. Mesaba Energy Project



3.4.2 Water Effluents

The allowable quantity and concentration of chemical species in wastewater discharges from the IGCC Power Station are dependent in large part on the characteristics of potential receiving waters in the Project's vicinity. In the case of the West Range and East Range Sites, the receiving waters are located in different watershed basins that have greatly different water quality criteria.

Importantly with respect to wastewater discharges, the East Range Site is located within the Lake Superior Basin watershed, and the standards that apply to discharges of bioaccumulative chemicals of concern ("BCCs") in that basin effectively preclude discharges of cooling tower blowdown from Mesaba One and Mesaba Two. The reason for such discharge prohibitions is that mercury – a BCC – is found in the source waters for the East Range Site at concentrations nearly equal to the water quality criteria standard applied to end-of-the-pipe discharges.

Water quality criteria applied to waters located within the Lake Superior Basin are defined at Minn. R. 7052.0211, subp. 3 ("Mixing zones for bioaccumulative chemicals of concern [BCC]"):

> After March 9, 1998, acute and chronic mixing zones shall not be allowed for new and expanded discharges of bioaccumulative chemicals of concern (BCC) to the Lake Superior Basin.

Paragraph K of Minn. R. 7052.0350 confirms mercury as a BCC. The water quality criterion for mercury in all waters within the Lake Superior Basin watershed is 1.3 nanograms per liter. The combination of this criterion and the elimination of a mixing zone for BCCs are of great concern to facilities that would otherwise try to operate cooling towers within the Lake Superior Basin watershed. The reason for the concern arises because the median concentration of mercury in water recently sampled in two of the main pits from which water supplies for the IGCC Power Station would be appropriated is on the order of 0.75 nanograms per liter. This means that the cycles of concentration at which the cooling towers could operate would be reduced so severely as to result in extreme pumping costs and provide practically no margin of error to comply with the Lake Superior Basin's water quality criterion for mercury.

The most effective solution for eliminating uncertainties on the East Range Site tied to permitting discharges of cooling tower blowdown containing mercury is to totally eliminate the discharge of cooling tower blowdown. This can be done by enlarging the zero liquid discharge system to handle all of the IGCC Power Station's non-domestic wastewater streams. In this configuration, the IGCC Power Station would be designed to evaporate whatever water cannot be reused in the plant processes, and leave only a solid stream of salts for disposal at a licensed non-hazardous treatment/disposal facility. This scheme would significantly increase the cost of the IGCC Power Station but would allow for the utilization of the East Range Site and/or any other location within the Lake Superior Basin.

3.4.2.1 Site Independent Features of IGCC Power Station

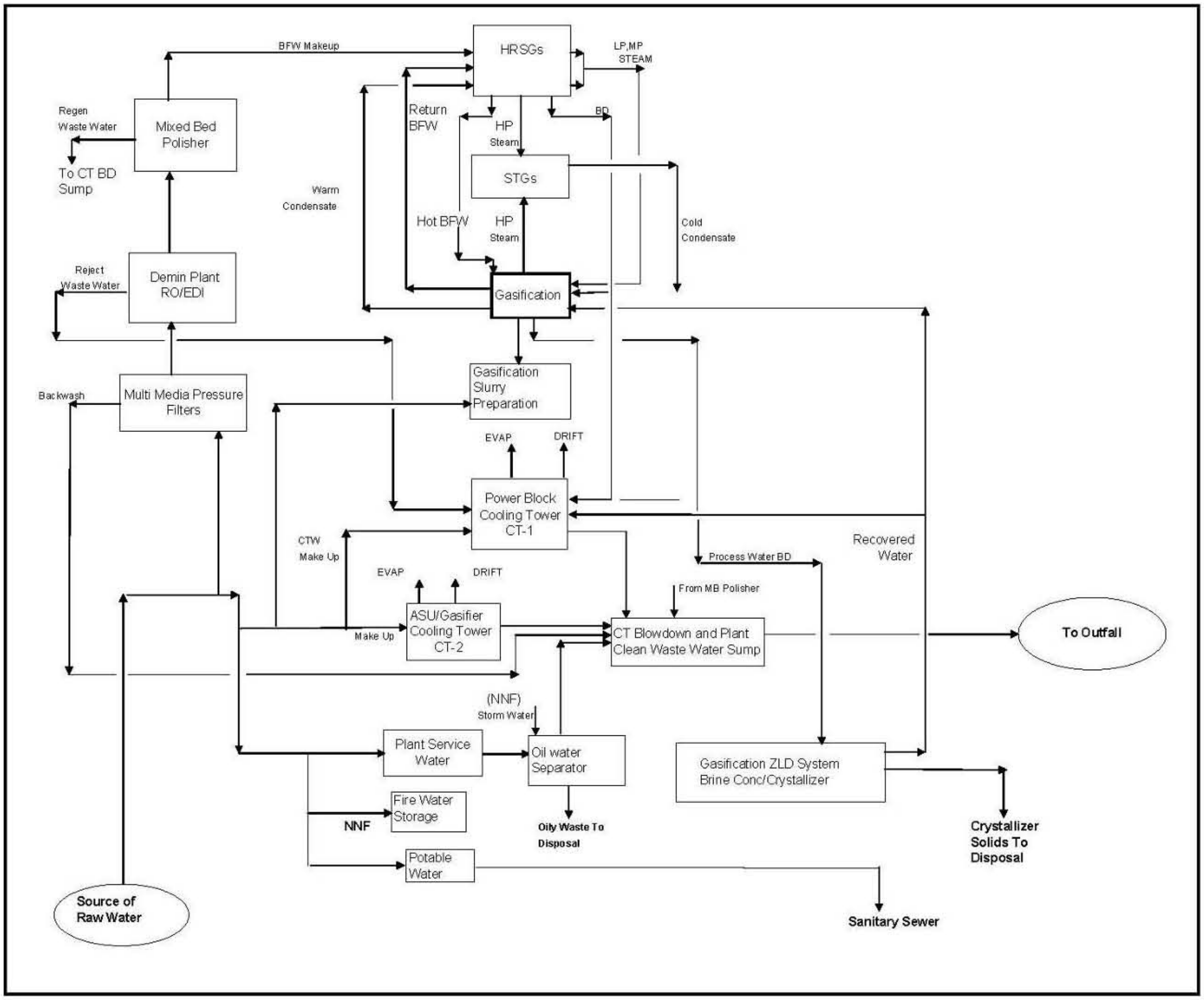
3.4.2.1.1 Commonalities: Introduction

Although differences in the amounts of water appropriated, consumed, and discharged will vary between the West and East Range Sites, the general requirements for water will be the same as those specified in Section 3.3.4. A generalized water balance diagram that applies to each the Phase I and Phase II Developments at either Site is shown in Figure 3.4-5.

3.4.2.1.2 Zero Liquid Discharge System: Gasification Island

The gasification island will incorporate a significant environmental feature to protect the quality of local streams and lakes. That is, wastewater (generated from gasification and slag processing operations) containing certain levels of heavy metals and other contaminants from the feedstocks will be treated in a state-of-the-art ZLD system. This system will recover distilled water for reuse in the power plant, reducing fresh water consumption, and, more importantly, concentrate heavy metals and other contaminants of concern into a solid waste stream (see Section 3.4.4). This solid waste will be effectively disposed of in approved waste management facilities. Therefore, no wastewater streams from the ZLD system serving the gasification island will require disposal at either site (see Figure 3.4-5).

Figure 3.4-5 Water Balance Diagram Showing Integration of ZLD System into Gasification Island in Mesaba One and Two Design*



NNF = normally no flow.
*In the case of the East Range Site, cooling tower blowdown is routed to a second ZLD system to avoid discharges to surface waters in the Lake Superior Basin watershed (see Figure 3.6-1).

3.4.2.1.3 Storm Water Management

3.4.2.1.3A Pre-Construction

Environmentally sensitive areas outside the Station Footprint (and other developed areas) will be identified prior to the start of construction. These locations will be clearly delineated and will not be disturbed during site preparation activities. Best Management Practices ("BMPs") for storm water runoff will be identified, adopted and implemented during this time period.

3.4.2.1.3B Construction

Initial site preparation activities will include building access roads, clearing brush and trees, leveling and grading the area encompassing the Station Footprint and temporary construction-support features, bringing in necessary utilities, and undertaking dewatering activities that may be required. Trucks will be required to bring in fill material for roadways and the Power Station Footprint, remove harvested timber, remove debris from the site, and stockpile fill material. Gravel and road base will be utilized for the temporary roads, material storage, and parking areas as noted in Figure 3.2-8.

In accordance with 40 C.F.R. part 122.26(b)(14)(x), the Applicant will develop and submit to the MPCA prior to undertaking any construction activities a Storm Water Pollution Prevention Plan (SWPPP) that identifies erosion prevention and sediment BMPs. The plan will include specific identification of foreseeable conditions and proposed practices to properly address all such identified conditions during the various stages of construction and post construction. The plan will include a description of the nature of the construction activity and address and contain the following:

- Potential for discharging sediment and/or other potential pollutants from the Power Station Footprint and Buffer Land.
- Location and type of all temporary and permanent erosion prevention and sediment control BMPs, along with procedures to be used to establish additional temporary BMPs as necessary for the construction site.
- Construction site maps with existing and final grades, including dividing lines and direction of flow for all pre and post-construction storm water runoff drainage areas located within the Project limits. The construction site maps will also include impervious surfaces and soil types.
- Locations of areas not to be disturbed.
- Location of areas where construction will be phased to minimize duration of exposed soil areas.
- All surface waters and existing wetlands, which can be identified on maps such as United States Geological Survey 7.5 minute quadrangle maps or equivalent maps within one-half mile from the Project boundaries, which will receive storm water runoff from the construction site, during or after construction.
- Methods to be used for final stabilization of all exposed soil areas.

<u>Operation</u>

Storm water generated during operation of the IGCC Power Station will be managed in three ways. Storm water with potential to become contaminated with process solids/liquids will be segregated from process equipment by curbs, elevated drain funnels and other means and returned as make-up to the feedstock slurrying system or for other process water use.

Storm water that could become contaminated with oil (such as water runoff from parking lots) will be routed through an oil/water separator and then to the cooling tower blow down sump prior to discharge off-site.

Storm water from other areas not associated with industrial activity will be routed to the storm water detention pond where settling can occur and initial rainfall ("first flush") can be contained, checked, and released in a controlled manner to a permitted outfall.

3.4.2.1.4 Sanitary Discharges

The sanitary wastewater produced during operation of the IGCC Power Station will be relatively small (about 30 gallons per person per day) and will be discharged to nearby Publicly Owned Treatment Works ("POTW"). In the case of the West Range Site, the closest POTW is the regional system located in Bovey. The Bovey POTW would be accessed via the City of Taconite sanitary sewer system. In the case of the East Range Site, the closest POTW is the Hoyt Lakes wastewater treatment plant. The Hoyt Lakes POTW would be accessed via a new pipeline constructed by the City. As an alternative, sanitary wastewaters from plant activities could be treated in an on-site septic system.

3.4.2.2 West Range (Preferred Site)

In the case of the West Range IGCC Power Station, the chemistry of the water effluent streams is inextricably linked to the chemistry of the Station's source waters. The reason for this strong link is that the only discharge to West Range receiving waters will be cooling tower blowdown (see Section 3.4.2.2.2).

3.4.2.2.1 Introduction: Water Requirements, Water Use Flow Diagram and Receiving Waters

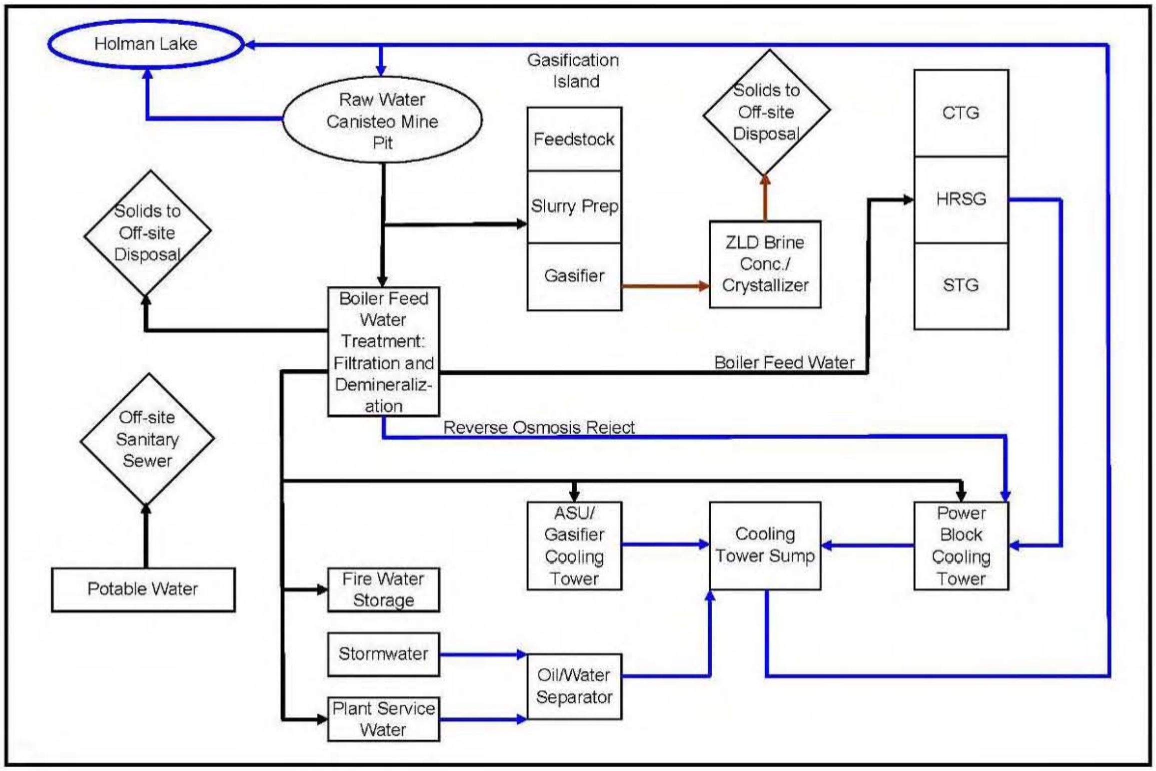
Information regarding water requirements for the IGCC Power Station and a generalized water use block flow diagram for the West Range Site are presented in Table 3.4-16 and Figure 3.4-6, respectively.

Table 3.4-16
West Range Water Appropriation Requirements

Phase	Average Annual Appropriation (GPM)	Peak Appropriation (GPM)
I	4,000[a]-4,400[b]	6,500
I and II	8,800[b]-10,300[c]	15,200

[a]Based on 8 COC in the gasification island and the power block cooling towers
[b]Based on 5 COC in the gasification island and the power block cooling towers
[c]Based on 3 COC in the gasification island and the power block cooling towers

Figure 3.4-6 IGCC Power Station Water Use Flow Diagram—Phases I and II



As shown in Figures 3.4-6 and 3.4-7, the receiving waters for the West Range Site will be the Canisteo Mine Pit (“CMP”) and Holman Lake. The location of these waters relative to the IGCC Power Station is shown in Figure 3.4-8.

Figures 3.4-6 and 3.4-7 show that the CMP would also serve as the source of water for the IGCC Power Station. The Applicant’s water management plan calls for other sources of water to be pumped into the CMP to provide sufficient water supplies and to maintain water levels and appropriate water chemistry. A general introduction to the water management plan is provided in Section 3.4.2.2.4. A detailed discussion of the water management plan is provided in Section 3.6.

Figure 3.4-7 Water Supply and Wastewater Discharge System Schematic

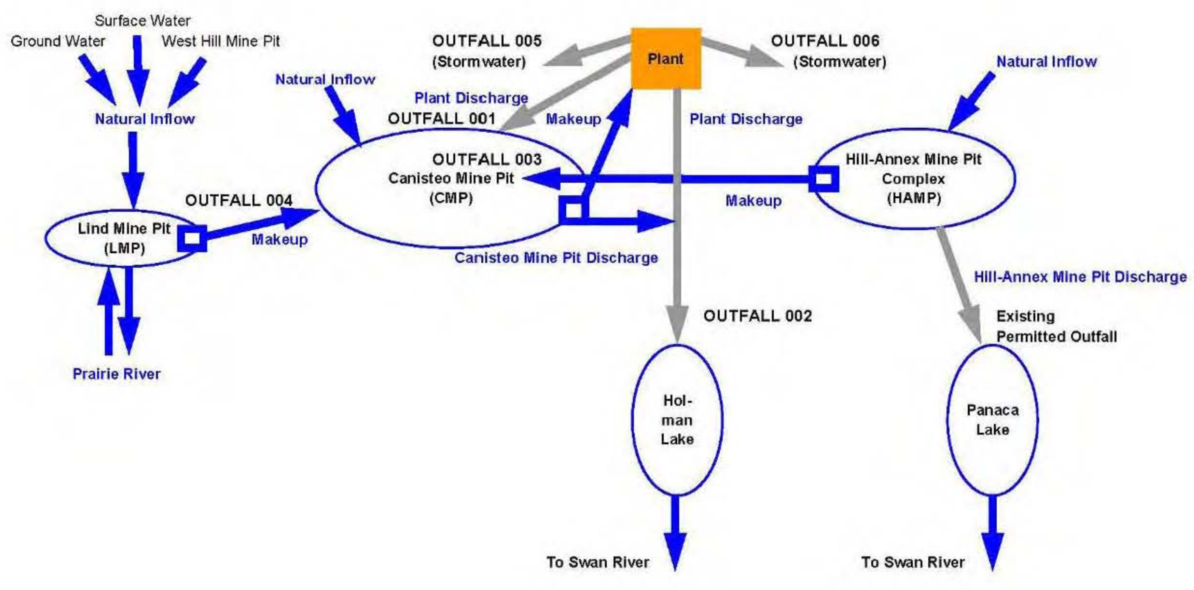
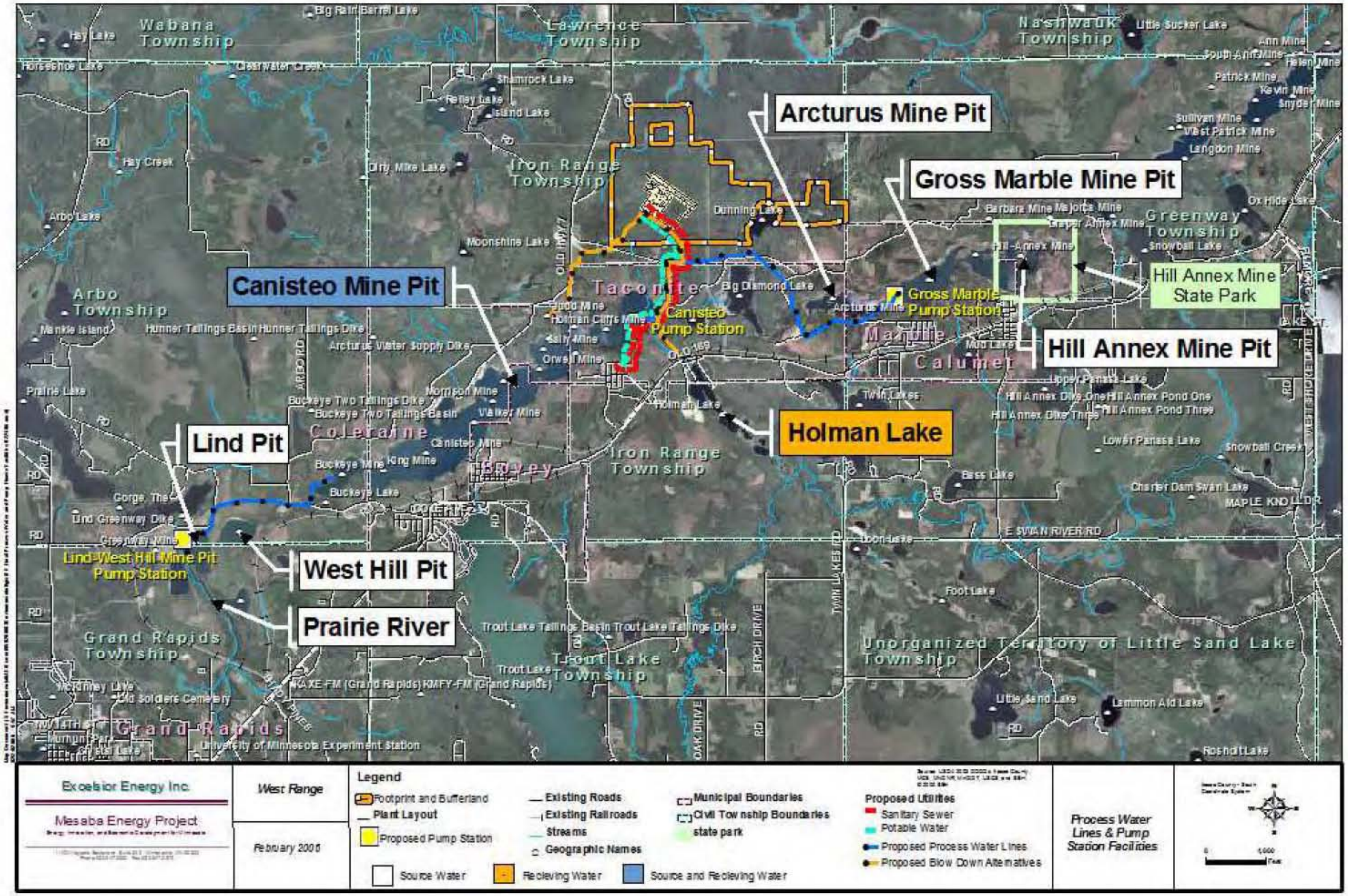


Figure 3.4-8 West Range Site Receiving Waters



3.4.2.2.2 Cooling Tower Blowdown

Because almost all of the wastewater discharged from the IGCC Power Station operations is due to the need to remove a portion of the condenser cooling water for control of dissolved solids (as noted previously in Section 3.3.4.2, this wastewater stream is referred to as "cooling tower blowdown"), the constituents in the discharge are essentially the same materials present in the water supply to the plant, but more concentrated. Based on the IGCC Power Station equipment operating requirements and source water quality, the plant cooling towers are expected to be limited to between approximately three to eight COC. Therefore, the contaminants in the cooling water blowdown could be concentrated (due to evaporation in the cooling tower) by about three to eight times the concentration in the water supply.

In general, the amount of cooling tower blowdown requiring discharge to receiving waters is calculated as follows:[10]

$$\text{Blowdown} = \frac{\text{Evaporation}}{\text{Cycles - 1}} - \text{Drift}$$

As determined by this formula, wastewater discharge rates to the CMP and/or Holman Lake will be inversely proportional to the cycles of concentration at which the cooling towers are operated. The number of cycles of concentration in the IGCC Power Station will be determined in large part by the concentration of mercury in the CMP waters, the water quality criteria standards for mercury, TDS and hardness, and the total mass of mercury discharged to Holman and Panasa Lakes as allowed under conditions of an NPDES permit issued to Mesaba One and Two.

The following outlines the Applicant's methodology for operating Mesaba One and Two (the methodology is fully discussed in Section 5.2.2.1 and Appendix D, both contained in the NPDES Permit application attached as Appendix 6). The IGCC Power Station will operate at five cycles of concentration during Phase I and at three cycles of concentration for Phase I and II. A portion of the IGCC Power Station effluent will be discharged to the CMP and a portion will be discharged to Holman Lake. The volume of water discharged directly to Holman Lake from the IGCC Power Station will be controlled such that the total mass of mercury discharged to the Swan River watershed (the sum of any future discharge from the Hill-Annex Mine Pit to Panasa Lake and the IGCC Power Station discharge directly to Holman Lake) will be no greater than the mass currently permitted to be discharged to the watershed from the Hill-Annex Mine Pit Complex ("HAMP Complex") . Importantly, the outcome of this operating scenario is no net increase in the mass of mercury permitted to be discharged to the Swan River watershed under the existing NPDES Permit (No. MN0030198) currently held by the Minnesota Department of Natural Resources ("MDNR"). The volume of water discharged directly to Holman Lake will be adjusted about every five years, or as needed during Phase I and II operation, to limit the mass of mercury discharged. The expected peak and annual average wastewater discharge rates for the IGCC Power Station are summarized in Table 3.4-17.

[10] Black & Veatch, 1996, "Power Plant Engineering," Page 525-26.

Table 3.4-17
Estimated Wastewater Discharge Rates To West Range Site Receiving Waters

	Cycles of Concentration	Peak Discharge (GPM)	Average Annual Discharge (GPM)
I	5	1,300	550-900
I and II	3	5,140	2,200-3,500

The estimated average annual consumptive and non-consumptive uses and flows contributing discharge to the CMP during operation of a single phase, based on five cycles of concentration in the gasification island and the power block cooling towers, are shown in Figure 3.4-9. The flows for combined Phase I and II operation and three cycles of concentration in the cooling towers are shown in Figure 3.4-10. Specific water uses related to the gasification island and the power block are described below.

Figure 3.4-9 Mesaba One: Water Uses Contributing to IGCC Power Station Discharge

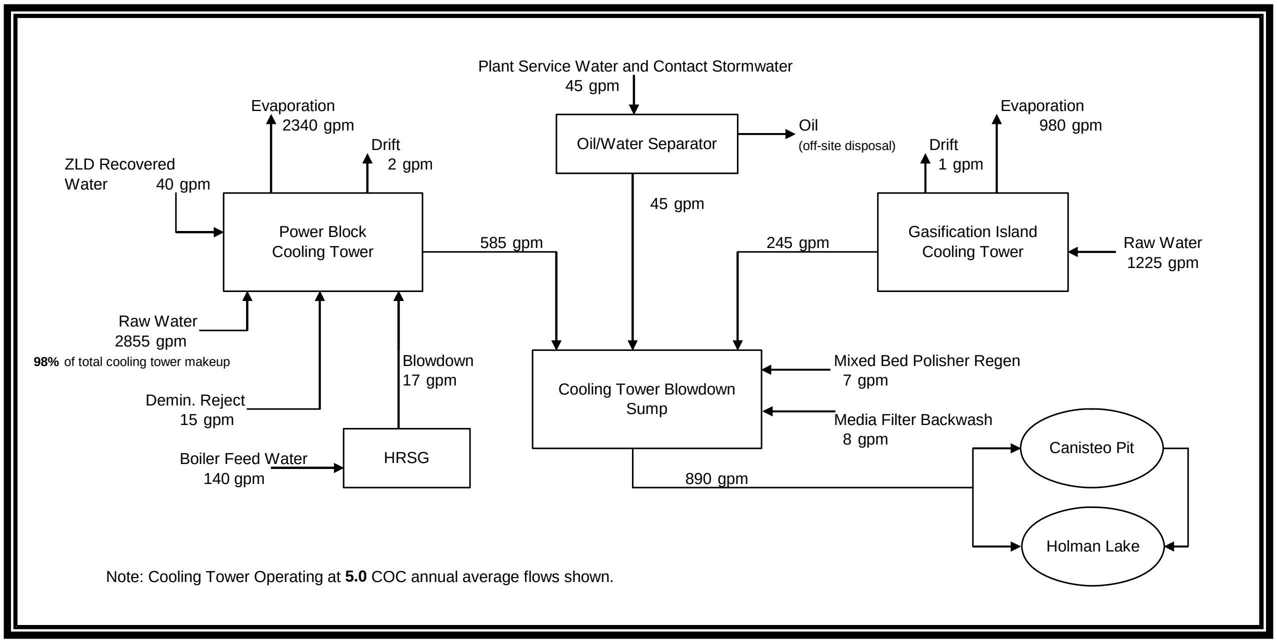
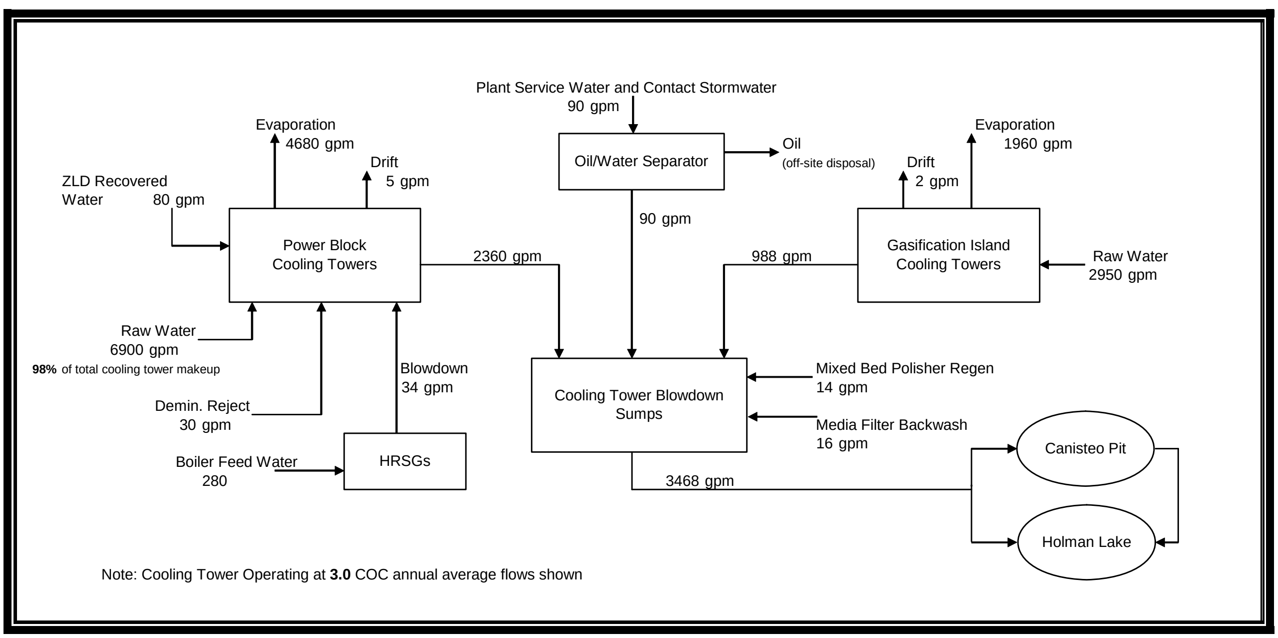


Figure 3.4-10 Mesaba One and Mesaba Two - Water Uses Contributing to IGCC Power Station Discharge



As shown in Table 3.4-18, the wastewater from the IGCC Power Station will consist mostly of cooling tower blowdown, blended with relatively low amounts of additional wastewater streams from other plant systems, including HRSG blowdown, reject water from the boiler feed water demineralizers, and treated storm water (processed through an oil/water separator) from plant drains isolated from contamination by process solids/liquids (see Figure 3.4-3).

Table 3.4-18 Wastewater Discharge Rate From Systems In The Phase I IGCC Power Station

Wastewater Component	Cycles of Conc.	Expected Discharge (GPM)	
		Ann. Avg.	Peak
Power Block Cooling Tower Blowdown	8	335	498
HRSG Demineralizer /RO Reject Water*	8	15	15
HRSG Blowdown*	8	17	17
Gasifier/ASU Cooling Tower Blowdown	8	140	209
Plant Service Water	8	45	45
Mixed Bed Polisher Regen./Backwash	8	15	15
Power Block Cooling Tower Blowdown	5	585	873
HRSG Demineralizer /RO Reject Water*	5	15	15
HRSG Blowdown*	5	17	17
Gasifier/ASU Cooling Tower Blowdown	5	245	366
Plant Service Water	5	45	45
Mixed Bed Polisher Regen./Backwash	5	15	15
Power Block Cooling Tower Blowdown	3	1,180	1,750
HRSG Demineralizer /RO Reject Water*	3	15	15
HRSG Blowdown*	3	17	17
Gasifier/ASU Cooling Tower Blowdown	3	494	732
Plant Service Water	3	45	45
Mixed Bed Polisher Regen./Backwash	3	15	15

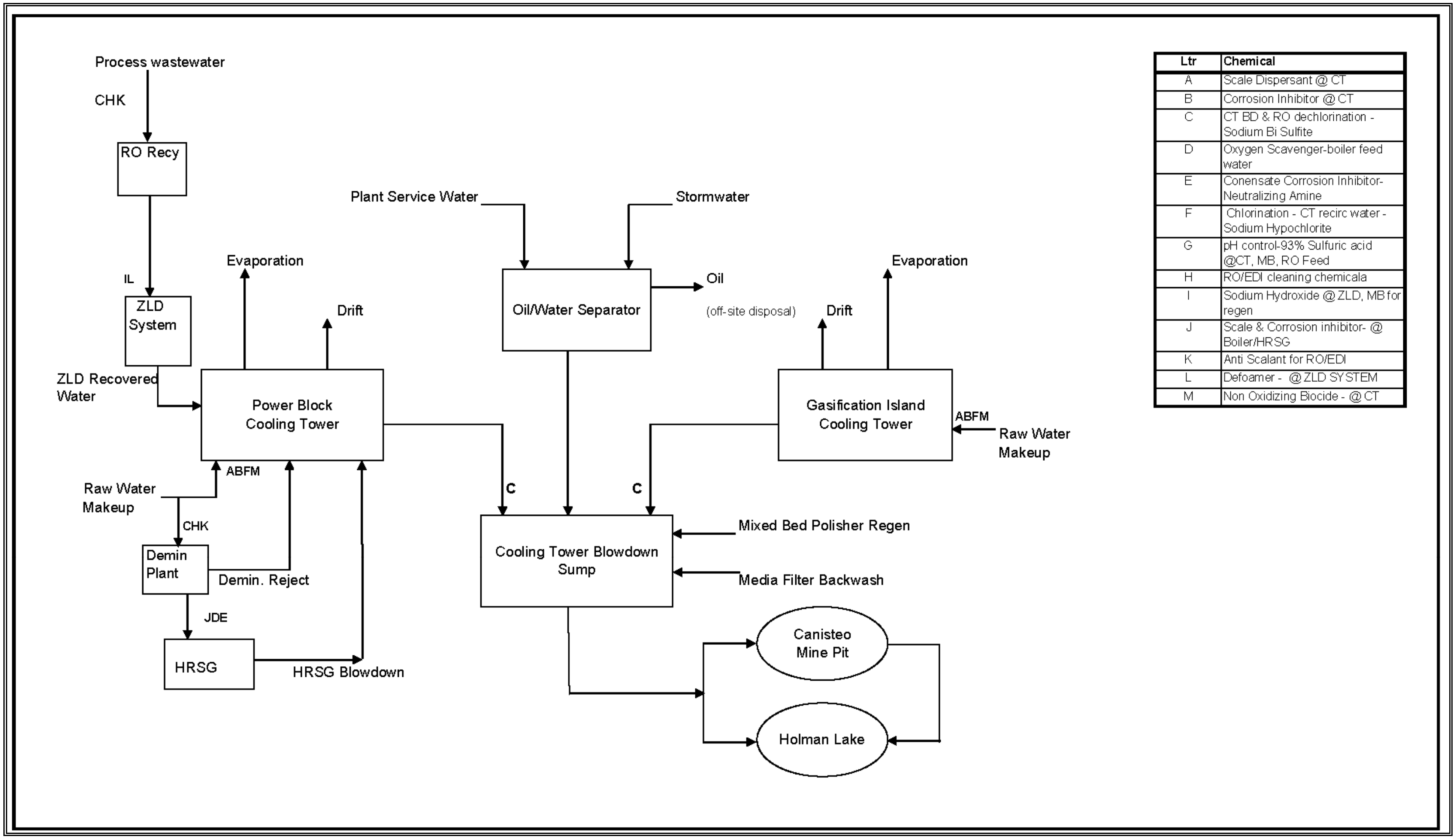
*The HRSG Demineralizer/RO Reject Water stream and HRSG Blowdown stream both discharge directly to the Power Block Cooling Tower and, therefore, would be reflected in the discharge from the Power Block Cooling Tower. For example, the average annual discharge from the IGCC Power Station assuming 8 cycles of concentration would be 535 gpm (335+140+45+15), not 567 (335+15+17+140+45+15).

The chemicals that are expected to be added to the circulating water system and the residual amounts that ultimately would be discharged from Mesaba One and Mesaba Two to receiving waters are identified and listed in Table 3.4-19. The Applicant has screened the chemicals identified in this table for phosphorous containing compounds and will establish in the design basis for the IGCC Power Station that use of such chemicals is to be avoided. These chemicals are primarily needed to control cooling water corrosion and fouling, and to neutralize certain undesirable constituents in the plant discharge stream. The point of introduction for each of the chemicals is indicated in the table and in Figure 3.4-11. Material Safety Data Sheets (MSDS) representative of the chemical additives are provided in Appendix C of the NPDES Permit Application attached as Appendix 6. The estimated combined chemical usage for Mesaba One and Mesaba Two is also listed (half the indicated amount would be used for Mesaba One). However, the majority of the chemicals would be consumed in the plant processes and only residual amounts would be present in the water ultimately discharged to the CMP and/or Holman Lake. These quantities are preliminary estimates only and are subject to revision when the specific water chemistry program for the facility is developed for submission to appropriate regulatory agencies for review and approval.

Table 3.4-19 Chemical Additives Used Per Year (Phase I and II)

Chemical	Point(s) Of Introduction	Estimated Usage (lbs/Year)	Estimated Residual In Discharge	Basis, % In Discharge
Scale Dispersant	Cooling Towers	75,000	750	1%
Corrosion Inhibitor	Cooling Towers	300,000	3000	1%
Dechlorination – Sodium bisulfite	Cooling Tower Blowdown Sump, Reverse Osmosis System	15,000 7500	150 75	1%
Oxygen Scavenger	Boiler Feed Water	6600	66	1%
Condensate Corrosion Inhibitor-Neutralizing Amine	Boiler Feed Water	2200	22	1%
Chlorination - Sodium Hypochlorite	Cooling Towers	300,000	1500	0.5%
pH control-93% Sulfuric acid	Cooling Towers, Reverse Osmosis, Mixed Bed	18,000 3000 11,000	36 6 22	0.2%
Sodium Hydroxide	Mixed Bed regeneration	11,000	0	(totally neutralized)
Scale and Corrosion inhibitor	Boiler/HRSG	13,000	130	1%
Anti-Scalant	Reverse Osmosis, Deionizer	150 200	2 2	1%
Non-Oxidizing Biocide	Cooling Towers	11,000	22	0.2%

Figure 3.4-11 Points of Chemical Addition in IGCC Power Station Circulating Water System



Ltr	Chemical
A	Scale Dispersant @ CT
B	Corrosion Inhibitor @ CT
C	CT BD & RO dechlorination - Sodium Bi Sulfite
D	Oxygen Scavenger-boiler feed water
E	Conensate Corrosion Inhibitor-Neutralizing Amine
F	Chlorination - CT recirc water - Sodium Hypochlorite
G	pH control-93% Sulfuric acid @CT, MB, RO Feed
H	RO/EDI cleaning chemicala
I	Sodium Hydroxide @ ZLD, MB for regen
J	Scale & Corrosion inhibitor- @ Boiler/HRSG
K	Anti Scalant for RO/EDI
L	Defoamer - @ ZLD SYSTEM
M	Non Oxidizing Biocide - @ CT

3.4.2.2.3 Source Water Quality

The water needs of the IGCC Power Station at the West Range Site will be met by appropriating water out of the following nearby abandoned mine pits; the CMP, the HAMP Complex, and the Lind Mine Pit ("LMP"). The Prairie River will also serve as a Water Resource, the use of which is described in the Applicant's overall water management plan. These Water Resources are shown in Figure 3.4-8 The current quality of each water source is summarized in Table 3.4-20. In general, the current concentration of each constituent is based on the median concentration of available qualified water quality analyses. Water quality data is provided in an appendix to the NPDES Permit Application provided in Appendix 6.

Table 3.4-20
Current Source Water Quality

Constituent	Water Source				
	Units	CMP	HAMP Complex	LMP	Prairie River
Hardness	mg/l	308	229	--[b]	--[b]
Alkalinity	mg/l	180	163	178	76
Calcium	mg/l	55.3	58.6	73.2	50
Magnesium	mg/l	40.8	20.5	--	22
Iron	mg/l	<0.05	<0.05	--	--
Manganese	mg/l	<0.02	<0.02	--	--
Chloride	mg/l	5.15	5.2	4.9	1.3
Sulfate	mg/l	103.5	59.5	--	<5
TDS	mg/l	337	254	402	--
pH	mg/l	8.4	8.3	7.7	7.4
Aluminum	ug/l	<25	<25	--	91
Barium	ug/l	28.6	29.7	--	--
Cadmium	ug/l	<10	<10	--	--
Chromium (6+)	ug/l	<5	<5	--	--
Copper	ug/l	<10	<10	--	--
Fluoride	mg/l	--	--	--	--
Mercury	ng/l	0.9	0.9	0.8[a]	0.59
Nickel	ug/l	<5	<5	--	--
Selenium	ug/l	<2	<2	--	--
Sodium	mg/l	6.6	6.2	5.0	2.5
Specific Conductivity	umhos/cm	476	418	--	171
Zinc (3)	ug/l	<10	<10	--	--
BOD	mg/l	<2	<2	--	--
COD	mg/l	<2	<2	--	--
TOC	mg/l	1.9	1.9	--	--
TSS	mg/l	1.5	1.5	--	--
Ammonia (as N)	mg/l	<0.1	<0.1	0.1	0.018
Phosphorus	mg/l	<0.1	<0.1	0.01	0.029

[a] For the mass balance computations presented in Section 5, it was conservatively assumed that the mercury concentration in the LMP is identical to that in the HAMP Complex and the CMP.
[b] --Indicates that no data was collected.

3.4.2.2.4 West Range Outfalls, Discharge Rates, and Receiving Water Quality

For the West Range Site, the direct receiving waterbodies for discharges of cooling tower blowdown from the IGCC Power Station will be the CMP and Holman Lake.

Holman Lake will receive discharges from the CMP for purposes of water level control in the CMP and/or to maintain water quality within that Pit (to keep the concentration of solids from building up).

Figure 3.4-12 and Figure 3.4-13 show the expected discharge outfalls for Mesaba One and Mesaba One and Two, respectively. The combination of surface flow/infiltration of water to the CMP, the input of excess water from the HAMP Complex, and the discharge of water from the CMP (or directly from the Power Station) to Holman Lake would act to reduce the concentration of mineral constituents in the CMP. The locations of the discharge outfalls are shown on Figure 3.4-14.

Figure 3.4-12 Phase I Water Operations Flow Rates: West Range Site

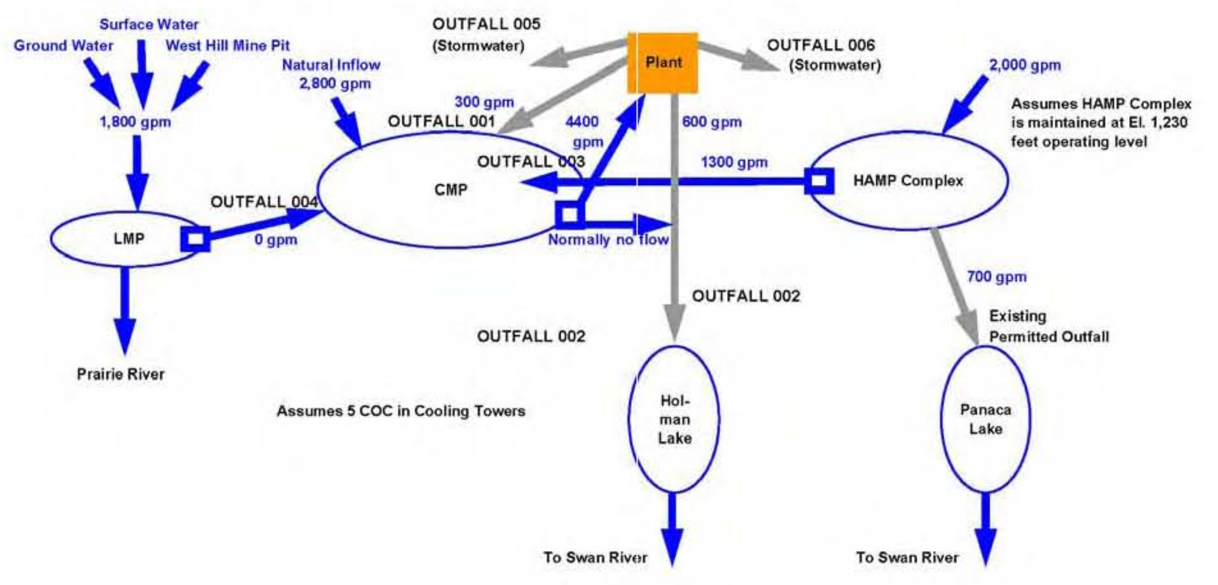


Figure 3.4-13 Phase I and II Water Operations Flow Rates: West Range Site

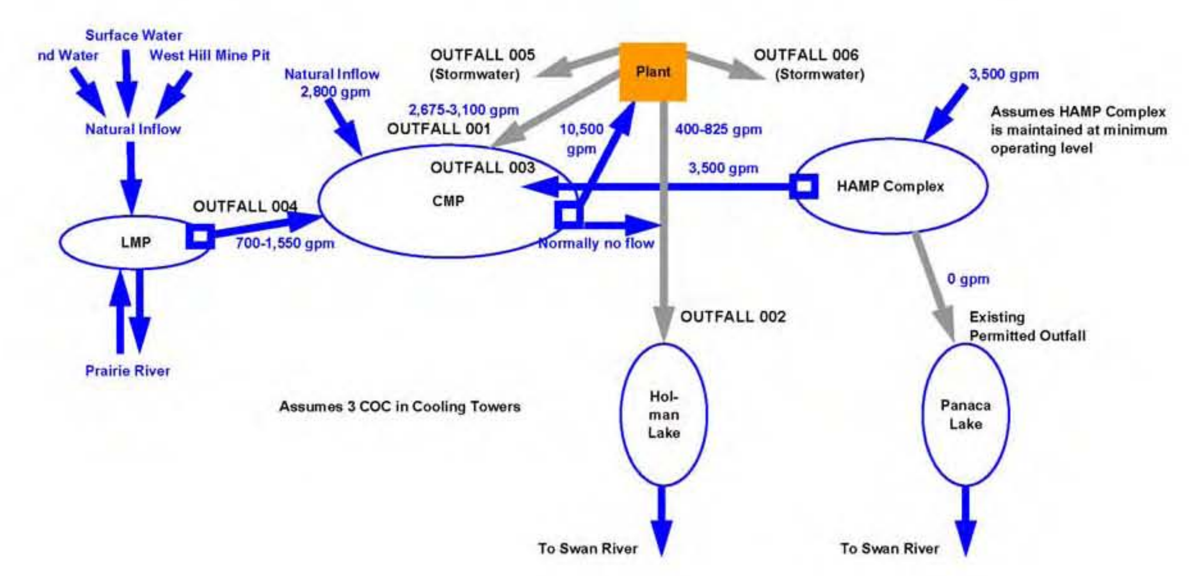
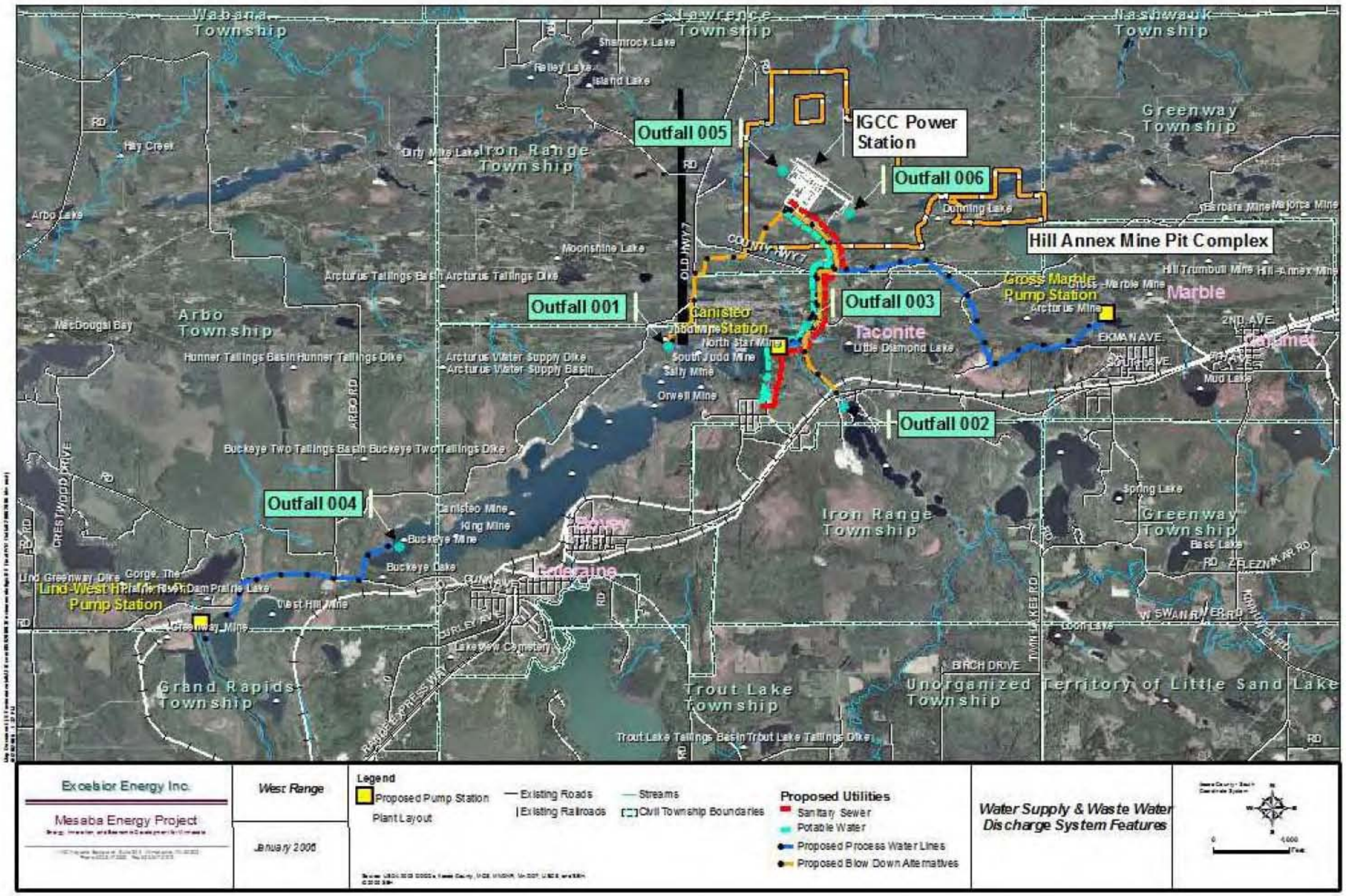


Figure 3.4-14 NPDES Outfall Locations: West Range Site



The expected average annual flow rate and proposed permitted peak flow rate for each outfall for Phase I and Phase I and II operation are summarized in Table 3.4-21. The expected average annual discharge rates are based on the water balances presented in Figures 3.4-12 and 3.4-13. The proposed peak discharge rates are based on modeled peak rates plus additional capacity to provide operational flexibility.

Table 3.4-21
Discharge Flow Rates

Outfall	Phase I		Phase I and II	
	Average (gpm/MGD)	Peak (gpm/MGD)	Average (gpm/MGD)	Peak gpm/MGD)
001	900/1.3	3,000/4.3	3,500/5.0	6,000/8.6
002	600/0.9[a]	3,000/4.3	825/1.2[a]	6,000/8.6
003	2,000/2.9	7,000/10.1	3,500/5.0	7,000/10.1
004	0	0	1,800/2.6	7,000/10.1
005	To be determined	To be determined	To be determined	To be determined

[a] Limited by mercury mass discharge.

The current water quality of the receiving water is provided in Table 3.4-22.

Table 3.4-22
Current Water Quality of Receiving Waters

Constituent	Units	CMP	Holman Lake
Hardness	mg/l	308	--[a]
Alkalinity	mg/l	180	186
Calcium	mg/l	55.3	50.2
Magnesium	mg/l	40.8	--
Iron	mg/l	<0.05	0.75
Manganese	mg/l	<0.02	0.04
Chloride	mg/l	5.15	8.4
Sulfate	mg/l	103.5	10.1
TDS	mg/l	337	236
pH	mg/l	8.4	7.9
Aluminum	ug/l	<25	--
Barium	ug/l	28.6	--
Cadmium	ug/l	<10	--
Chromium (6+)	ug/l	<5	--
Copper	ug/l	<10	--
Fluoride	mg/l	n/a	--
Mercury	ng/l	0.9	<4.0
Nickel	ug/l	<5	--

Constituent	Units	CMP	Holman Lake
Selenium	ug/l	<2	--
Sodium	mg/l	6.6	7.4
Specific Conductivity	umhos/cm	476	--
Zinc (3)	ug/l	<10	--
BOD	mg/l	<2	--
COD	mg/l	<2	--
TOC	mg/l	1.9	--
TSS	mg/l	1.5	--
Ammonia (as N)	mg/l	<0.1	<0.1
Phosphorus	mg/l	<0.1	0.01

[a] – Indicates that no data was collected.

A comparison of expected IGCC Power Station discharges and applicable state numerical water quality standards (Minn. R. 7050.0222) is summarized in Table 3.4-23. None of the abandoned mine pits is listed on the PWI or are published in rules that Class 2B water standards are applicable (Minn. R. 7050.0430). Holman Lake is listed on the PWI, but not in Minnesota Rules, so Class 2B water standards apply. In the absence of formal guidance with respect to the "classification of the West Range Water Resources, the Proponent has determined that the Class 2B water standards are applicable (Min. R. 7050.0430).

Table 3.4-23
Expected IGCC Power Station Discharges and Applicable State Numerical Water Quality Standards

Constituent	Units	Class 2 WQ Standard	Anticipated Effluent Water Quality – Phase II (5 COC)	Anticipated Effluent Water Quality – Phase II (3 COC)
Hardness	mg/l	250	0 .07	0.03
Alkalinity	mg/l	n/a	--	--
Calcium	mg/l	n/a	--	--
Magnesium	mg/l	n/a	--	--
Iron	mg/l	n/a	--	--
Manganese	mg/l	n/a	--	--
Chloride	mg/l	230	38	16
Sulfate	mg/l	n/a	470	280
TDS	mg/l	700	2,317	1,039
pH	mg/l	6 - 9	6 - 9	6 - 9
Aluminum	ug/l	125	73	31
Arsenic	ug/l	53	Note 4	Note 4
Barium	ug/l	n/a	--	--
Cadmium	ug/l	2.0[1]	Note 3	Note 3
Chromium (6+)	ug/l	32[1]	Note 3	Note 3
Copper	ug/l	15[1]	Note 3	Note 3
Fluoride	mg/l	n/a	--	--

Constituent	Units	Class 2 WQ Standard	Anticipated Effluent Water Quality – Phase II (5 COC)	Anticipated Effluent Water Quality – Phase II (3 COC)
Mercury	ng/l	6.9	6.6	2.8
Nickel	ug/l	283[1]	37	16
Selenium	ug/l	5	Note 3	Note 3
Sodium	mg/l	n/a	--	--
Specific Conductivity	umhos/cm	1000	12,380	1,400
Zinc (3)	ug/l	191[1]	Note 3	Note 3
Phosphorus	mg/l	1[2]	0.07	0.03

[1] indicates a hardness based standard. It is assumed hardness in the receiving water is >200 mg/L based on available data.
[2]phosphorus standard is an effluent limit and not a water quality standard.
[3]results below detection limit.
[4]not analyzed.

A mass balance model was constructed to estimate the IGCC Power Station effluent water quality over various periods of operation of the IGCC Power Station and under various operating scenarios. The model is described and detailed study results are presented in Appendix D of the NPDES Permit Application attached as Appendix 6 to this Joint Permit Application. The model calculates the anticipated water quality from the IGCC Power Station discharge and that anticipated in the CMP as a result of various inflows from the HAMP Complex and the LMP, and discharges from the IGCC Power Station.

The modeling results indicate that key water quality constituents associated with Outfall 001 and 002 discharges will be mercury, total dissolved solids (TDS), and hardness. As shown below, mercury will be addressed by operating the IGCC Power Station such that the concentration of mercury in its effluent discharges will not exceed the water quality standard of 6.9 ng/L. In addition, operation of the system will be such that the mass of mercury discharged to Holman Lake through Outfall 002, combined with the mass of mercury discharged to Panasa Lake from the continued pumping of the HAMP Complex, will not exceed the mass of mercury currently permitted to be discharged to Panasa Lake under existing NPDES Permit No. MN0030198. Both Holman Lake and Panasa Lake are tributary to the Swan River. Therefore, this system will not contribute additional pollutants to the Swan River watershed. TDS and hardness discharge concentrations will be acceptable with the inclusion of a mixing zone as allowed under Minn. R. 7050.0210, subp. 5.

The volume of water discharged directly to Holman Lake will be adjusted approximately every five years, or as needed during Phase I and II operation, to limit the mass of mercury discharged to Holman Lake.

Similarly, it is anticipated that the concentration of sulfate in the IGCC Power Station discharge water will also increase over time and concern has been raised regarding the link between sulfate and methyl mercury. However, as with mercury, no additional mass of sulfate will be discharged to the Swan Lake watershed from the IGCC Power Station. While it has been demonstrated that the addition of sulfate may stimulate the formation of methyl mercury in peatlands (Branfireun et al. 1999; 2001)[11], the relationship may depend on several variables in addition to sulfate. These include organic carbon, the fraction of bioavailable mercury, and the microbial community structure (not all sulfate reducing bacteria methylate mercury) (Porvari and Verta 1995; Branfireun et al. 1999; Macalady et al. 2000).[12] In addition, the thermal modeling presented in Section 5.3 below has demonstrated that the discharge water from the IGCC Power Station is anticipated to remain at or near the surface of the receiving water and will have limited mixing with the bottom waters.

The reader is referred to Appendix 6 for a complete discussion of the mass balance conducted in support of demonstrating that there will be no increase in the mass discharges to the Swan Lake watershed above those that are presently permitted.

3.4.2.3 East Range (Alternate Site)

3.4.2.3.1 Management of Cooling Tower Blowdown

Discharge of cooling tower blowdown to any receiving waters in the Lake Superior Basin watershed is likely infeasible in the absence of use of an existing permit having sufficient discharge rights, and whose operating authority could be transferred to the Applicant. The Applicant is not aware of the existence of any such permits.

The Hoyt Lakes POTW was considered as an alternative but was determined to not have sufficient existing capacity to manage the quantities of cooling tower blowdown that would be produced. In addition, an expansion of the existing system cannot be undertaken without a major non-degradation study.

These options, in addition to uncertainties associated with treating the IGCC Power Station's cooling tower blowdown to remove mercury, were deemed less likely to be approved than the ZLD system described above.

Expanding the capacity of the ZLD system would leave domestic wastewater as the only effluent discharge from the IGCC Power Station on the East Range Site. The option selected for dealing

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[11] Branfireun BA, Roulet NT, Kelly CA & Rudd JWM (1999) In situ sulphate stimulation of mercury methylation in a boreal peatland: toward a link between acid rain and methylmercury contamination in remote environments. Global Geochemical Cycles 13: 743-750.

Branfireun BA, Bishop K, Roulet NT, Granberg G & Nilsson M (2001) Mercury cycling in boreal ecosystems: The long-term effect of acid rain constituents on peatland pore water methylmercury concentrations. Geophys. Res. Lett. 28: 1227-1230.

[12] Macalady JL, Mack EE & Scow KM (2000) Sediment Microbial Community Structure and Mercury Methylation in Mercury-Polluted Clear Lake, California. Appl. Environ. Microbiol. 66: 1479.

Porvari P & Verta M (1995) Methylmercury production In flooded soils - a laboratory study. Water, Air, and Soil Poll. 80: 765-773.

with this waste stream is identified in Section 3.6.4.2 of this Application; the alternatives considered are provided in Section 1.12.6.3 of the ES.

3.4.3 Pollution Prevention, Recycling and Reuse Plans

3.4.3.1 Site Independent Features

The IGCC Power Station will be designed to minimize process-related discharges to the environment and will represent a significant step toward demonstrating industrial ecology in the use of coal for power generation. Mesaba One and Mesaba Two will stand out as a state-of-the-art example of incorporating pollution prevention concepts into practically every aspect of the IGCC Power Station's design and operational plan. The following are the key pollution prevention, recycling, and reuse features that will be employed as part of that plan:

3.4.3.1.1 Spill Prevention Control and Countermeasure (SPCC) Plan

The SPCC Plan will anticipate contingency spill events, thereby insulating environmental media from the effect of accidental releases. All above ground chemical storage tanks will be lined or paved, curbed/diked, and have sufficient volume to meet all regulatory requirements.

Each Project Site will have a drainage plan that isolates routine process-related operations from affecting the surrounding environment.

3.4.3.1.2 Feedstock Material Handling

The feedstock storage area is paved or lined so that runoff can be collected, tested, and treated as necessary. The feedstock storage area has facilities to control fugitive dust emissions. The feedstock conveyors are covered.

3.4.3.1.3 Feedstock Grinding and Slurry Preparation

The feedstock grinding equipment is enclosed and any vents will be collected and routed to the tank vent boiler/auxiliary boiler. The water used to prepare the feedstock slurry includes stripped process condensate (recycled).

3.4.3.1.4 Gasification, High Temperature Heat Recovery, Dry Char Removal and Slag Grinding

The char produced in gasification is removed and recycled to the first stage of the gasifier. This improves carbon conversion in the gasifier and reduces the amount of carbon contained in the gasifier slag.

3.4.3.1.5 Slag Handling

The slag dewatering system generates some flash gas (gas released as a result of a rapid and significant drop in pressure to which a material is exposed) that contains H_2S. The flash gas will be recycled back to the gasifier via the syngas recycle compressor. Water that is entrained with the slag is collected and sent to the sour water stripper for recycle.

3.4.3.1.6 Sour Water System

Sour water is collected from slag dewatering and the low temperature heat recovery system, and the NH_3 and H_2S are stripped out and sent to the SRU. The stripped condensate is used to prepare coal slurry. Surplus stripped condensate is sent to the ZLD unit.

3.4.3.1.7 Zero Liquid Discharge Unit

The ZLD unit concentrates and evaporates the process condensate. The ZLD unit produces high purity water for reuse and a solid filter cake for disposal off site (the ZLD unit concentrates heavy metals and other contaminants into this filter cake). The ZLD is also a recycle unit since the recovered water is reused, reducing total plant water consumption.

3.4.3.1.8 COS Hydrolysis

The gasifier produces small quantities of COS that cannot be absorbed in the AGR system. The COS hydrolysis unit converts COS to H_2S so that it can be removed in the AGR unit. The COS hydrolysis unit improves the sulfur recovery efficiency of the Power Station and reduces the total amount of sulfur in the syngas, and ultimately, the release of SO_2 from the HRSG stacks.

3.4.3.1.9 Mercury Removal Features

The mercury removal unit uses specially formulated activated carbon to capture trace quantities of mercury that remain in the syngas. Mercury in the sour water handling system is captured via activated carbon filters strategically placed prior to potential release points.

3.4.3.1.10 Acid Gas Removal

The AGR system removes H_2S from the raw syngas and produces a sweet (low sulfur) syngas for use in the combined cycle power block. The AGR system produces concentrated H_2S feed for the SRU.

3.4.3.1.11 Sulfur Recovery Unit (SRU)

The SRU converts the H_2S to elemental sulfur that will be marketed for use as a fertilizer additive or for production of sulfuric acid. The tail gas from the SRU is recycled back to the gasifier. This eliminates the tail gas unit emissions commonly found in Claus plants.

3.4.3.1.12 Fuel Gas Moisturization

The fuel gas moisturization system improves the recovery of low level heat from the gasification process and serves as a diluent for the syngas used in the combustion turbines. Nitrogen from the ASU is also used as a diluent. Dry, clean syngas typically has a heating value in the range of 250 to 300 Btu/scf. If the dry syngas was used directly in the combustion turbines, the thermal NO_x formed would be too high. Earlier IGCC plants used steam injection for NO_x control, which is less efficient at reducing NO_X than using fuel moisturization and nitrogen.

3.4.3.1.13 Integration of the ASU and Power Block

The ASU produces nitrogen as a by-product which is an effective diluent for NO_x control. The ASU also requires large amounts of electrical power for air compression. Part of the air compression requirements will be provided by the combustion turbine compressors, further integrating the gasification and combined cycle power block portions. This integration reduces the ASU auxiliary power requirement and increases the Power Station's net electric output.

3.4.3.1.14 Other Reuse Plans

Boiler blowdown and steam condensate will be recovered from the combined cycle power block and gasification facilities, and will be reused as cooling tower makeup water.

3.4.3.1.15 Training and Leadership

Finally, all corporate and plant personnel will be trained in a culture focused on continuous operational improvement and environmental performance. Training and programs will include setting, measuring, evaluating and achieving performance and waste reduction goals.

3.4.3.2 West Range IGCC Power Station

One of the most important site dependent pollution prevention features of the West Range Site offers is the long term role it will play as a flood control mechanism for the Hill-Annex State Park and the communities, highways, and railroad facilities located south of the CMP. Although there may be other means to control the flooding threat in these locations, none offers the Power Station's capability for water reuse and its attendant socio-economic benefits.

3.4.3.3 East Range IGCC Power Station

Eliminating cooling tower blowdown discharges from the IGCC Power Station that would be constructed on the East Range Site (via the ZLD system described in Section 1.8.2.3) provides significant pollution prevention opportunities and operational synergies with nearby projects that either have acquired construction permits or are in the environmental review/permitting process. The other nearby projects must cope with similar issues regarding stringent regulations for process water discharges in the Lake Superior Basin watershed. Further, the MPCA must cope with existing stringent rules to license and permit such projects, realizing the socio-economic benefits they will bring. The IGCC Power Station equipped with the ZLD system to eliminate cooling tower blowdown may allow Mesaba One and Mesaba Two to utilize as source water the process wastewaters released by nearby projects. This feature could integrate well with the proposed industrial mining facilities to be located on CE's properties by eliminating wastewaters that would otherwise represent new discharges to impaired waters downstream.

The IGCC Power Station's possible later in-service date relative to other projects' start-up dates is not a fatal flaw to this water management concept. The Applicant will use the 2West Extension ("2WX") Mine Pit as a reservoir from which to supply water to the IGCC Power Station. Until the IGCC Power Station is ready to take water from the 2WX Mine Pit, other projects could potentially direct their effluent waters there for intermediate storage.

3.4.4 Solid Waste Generation, Handling, and Treatment/Disposal

Solid wastes produced at either Site will include miscellaneous janitorial streams associated with clean-up of the IGCC Power Station, commercial waste paper, spent activated carbon beds, and spent catalyst materials (associated with the COS hydrolysis and SRU systems). The solid waste stream produced by the ZLD system is discussed in Section 3.4.4.1.3 below. Off-site disposal of wastes that cannot otherwise be recycled or reused on-site will be conducted in compliance with all local, State and Federal rules and regulations.

Slag and elemental sulfur produced as a result of the mineral matter and sulfur contained in the feedstocks utilized are considered to be potential revenue producing streams that will be actively marketed.

3.4.4.1 Operational Wastes

3.4.4.1.1 Site Independent Listing of Operational Wastes

Table 3.4-24 summarizes the expected waste streams that will be generated during operation of the Phase I and II IGCC Power Station. These estimates are based on experience gained at Wabash River and adjusted for differences in capacity and configuration. Operational wastes generally include the following process wastes:

- Spent catalysts, adsorbents, and process solvents
- Used oils and fluids
- Cleaning and maintenance wastes
- Miscellaneous materials

3.4.4.1.2 West Range Site

The West Range Site has no additional operational wastes to add to the list in Table 3.4-24.

3.4.4.1.3 East Range Site

Residual solids from the ZLD system serving the power block and gasification island cooling towers will be produced in addition to the materials listed in Table 3.4-24. The worst case amount of solids produced is based upon the highest TDS levels measured in any of the mine pit waters, which in this case were measured in Mine Pit No. 6 (1,800 mg/L, see Section 3.4.1.1.6). At a peak make-up rate of 5,060 gpm for Mesaba One and 5,060 for Mesaba Two, and assuming worst case water quality, the peak solids produced by this system would total about 109 tons per day:

$$\text{Solids} = 5{,}060 \text{ gal/min-phase} * 2 \text{ phases} * 8.33 \text{ lb/gal} * 1{,}440 \text{ min/day} * 1{,}800 \text{ lbs}/10^6 \text{ lbs water} * 1 \text{ ton}/2000 \text{ lbs} \approx 109 \text{ tons/day}$$

On an annual average basis, make up to the cooling towers is projected to be 3,400 gpm. Using the same worst case water quality conditions noted above, the solids production rate would be about 73 tons per day:

Solids = 3,400 gal/min-phase*2 phases*8.33 lb/gal*1,440 min/day*1,800 lbs/10^6 lbs water*1 ton/2000 lbs
≈ 73 tons/day

Assuming a 92% capacity factor, total solids production from the ZLD system would be about 24,500 tons per year.

Table 3.4-24 Estimated Operational Waste Streams (Phase I and II)

Waste Description	Comments	Annual Quantity	H/NH*	Likely Disposition
Used Catalysts and Sorbents				
COS hydrolysis catalyst	Proprietary composition	42 tons	NH	Non-hazardous landfill
Hydrolysis catalyst support balls	Alumina silicate	14 tons	(NA)	Recycle
Claus sulfur recovery catalyst	Activated alumina	28 tons	NH	Non-hazardous landfill
Claus catalyst support balls	Activated alumina	10 tons	(NA)	Recycle
Hydrogenation catalyst	Cobalt Molybdenum	6 tons	(NA)	Metals reclaim
Hyd. catalyst support balls	Alumina silicate	2 tons	(NA)	Recycle
Amine regenerator carbon filter	Activated carbon	26 tons	H	Stabilize, hazardous waste landfill
Syngas treatment carbon	Activated carbon	60 tons	H	Stabilize, hazardous waste landfill
Mercury removal carbon	Impregnated carbon	14 tons	H	Stabilize, hazardous waste landfill
Sour water carbon	Activated carbon	48 tons	H	Stabilize, hazardous waste landfill
MDEA reclaim ion exchange	Ion exchange resin	0.4tons	NH	Non-hazardous waste landfill
Other Process Wastes				
ZLD filter cake (Gasification Island)	Inorganic and organic salts	4400 tons	H	Stabilize, hazardous waste landfill
Refractory brick and insulation	Gasifier repairs	360 tons	NH	Non-hazardous waste landfill
MDEA sludge	Reclaimer bottoms	10,000 gal	H	Incinerate or hazardous waste landfill
Sour water sludge	Char carryover in syngas	30 tons	H	Incinerate
Waste char and ash	Maintenance cleaning	160 tons	N	Non-hazardous waste landfill
Amine absorber residues	Iron and salts	20 yd^3	N	Non-hazardous waste landfill
Metallic filter elements		60 yd^3	H	Stabilize, hazardous waste landfill
Spent citric acid	Cleaning solution	40 drums	H	Approved disposal facility
Spent soda ash	Cleaning solution	40 drums	H	Approved disposal facility
Spent sulfuric acid	Line cleaning solution	14,000 gal	H	Approved disposal facility

Table 3.4-24 Estimated Operational Waste Streams (Phase I and II)

Waste Description	Comments	Annual Quantity	H/NH*	Likely Disposition
Off-line combustion turbine wash wastes	Detergent and residues	15,000 gal	Probably NH	Characterize, dispose as non-hazardous or hazardous wastes
HRSG wash water (infrequent)	Detergent, residues, neutralized acids	100,000 gal	Probably NH	Characterize, dispose as non-hazardous or hazardous wastes
Raw water treatment sludge and used water filter media	Solids removed from makeup water to plant	TBD	Probably NH	TBD
Miscellaneous Streams				
Used oil	Lube oils, oil from oil/water separator	8000 gal	(NA)	Send to reclaimer
Spent grease		16 drums	NH	Blend to gasifier feed
Miscellaneous solvents, coal tars		2 drums	H	Solvent reclaimer
Flammable lab waste		2 drums		Blend to gasifier feed
Scrap metal	Steel, aluminum, etc.	200 yd^3	NH	Recycle
Waste paper and cardboard	Office, shops, packing, etc.	320 yd^3	NH	Recycle
Combined industrial waste	Used PPE, materials, small amounts of refractory, slurry debris, etc.	320 yd^3	NH	Non-hazardous waste landfill

***Legend:** NH = Non-Hazardous; H = Hazardous; NA= Not Applicable

The environmental features of E-Gas™ technology avoid two significant solid waste streams – flue gas desulfurization (FGD) solids and ash – associated with other types of coal-based power generation:

- Conversion of mineral materials in the plant feed to a non-hazardous, marketable slag by-product eliminates the need to dispose of fly ash and bottom ash waste streams.[13] The properties of the slag product are described in Table 3.4-25.[14]
- Removal of sulfur from IGCC syngas in a relatively concentrated form and the subsequent production of elemental sulfur, another marketable by-product, eliminate the significant solid wastes that could result from the flue gas desulfurization process needed for other types of coal-based plants.

The use of a ZLD process will prevent the discharge of heavy metals and other gasification wastes with the plant wastewater effluent (Sections 3.1.6.3 and 3.4.2.1.2 present a description of the ZLD process). The solid waste stream from this process, consisting mainly of crystallized solids in a "filter cake," will likely be classified as a hazardous waste due to metals content and will be disposed in an approved hazardous waste landfill or other licensed facility. Table 3.4-26 presents a typical composition of ZLD filter cake from the system serving the gasification island, based on data from Wabash River.

Other wastes resulting from the operation and maintenance of the IGCC facility include:

- Worn and broken internal refractory from the gasifier vessel that is periodically removed and replaced.
- Spent activated carbon used for purification of syngas fuel, process solvents, and other purposes.
- Sludge resulting from internal amine solvent recycling.
- Detergents and used chemicals from cleaning of the power generation equipment and other facilities.

The Company will manage operational wastes in accordance with applicable regulations, good industry practices and established internal company procedures. Waste minimization and pollution prevention programs will be implemented (see Section 3.4.3). Hazardous and non-hazardous wastes will be properly collected, segregated, and recycled or disposed at approved waste management facilities within regulatory time limits and in accordance with requirements. Plant staff will be adequately trained in proper waste handling procedures. Waste manifests and other records and reporting will be maintained as required by regulations and company procedures.

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[13] In some plants that use wet limestone FGD or lime spray dryer FGD systems, a cost cutting step is to remove fly ash along with SO_2 in the post combustion flue gases and place the combined calcium sulfate/sulfite and ash mixture in an on-site landfill.

[14] Trace metals such as chromium, nickel, vanadium, etc., are captured in the impervious glassy matrix of the slag. The slag is non-hazardous, and will pass EPA's TCLP leachate test for metals, semi-volatile and volatile organics listed under RCRA.

Table 3.4-25 E-Gas™ Slag Properties

TCLP Metals	RCRA Regulatory Level, mg/l	Leachate from E-Gas Slag, mg/l
Arsenic	5	<0.1
Barium	100	<0.5
Cadmium	1	<0.5
Chromium	5	<0.1
Lead	5	<1
Mercury	0.2	<0.002
Selenium	1	<0.1
Silver	5	<0.1

Mesh Size	Wt. %
+8	28
+12	20
+16	20
-16	32

TCLP Organics	RCRA Regulatory Level, mg/l	Leachate from E-Gas Slag, mg/l
Pyridine	5	<0.05
1,4-Dichlorobenzene	7.5	<0.05
o-Cresol	200	<0.05
m- & p- Cresol	200	<0.05
Hexachloroethane	3	<0.05
Nitrobenzene	2	<0.05
Hexachloro-1,3-butadiene	0.5	<0.05
2,4,6-Trichlorophenol	2	<0.05
2,4,5-Trichlorophenol	400	<0.05
2,4-Dinitrotoluene	0.13	<0.05
Hexachlorobenzene	0.13	<0.05
Pentachlorophenol	100	<0.05

TCLP Volatile Organics	RCRA Regulatory Level, mg/l	Leachate from E-Gas Slag, mg/l
Vinyl Chloride	0.2	<0.005
1,1-Dichloroethylene	0.7	<0.005
Methyl Ethyl Ketone	200	<0.005
Chloroform	6	<0.005
1,2-Dichloroethane	0.5	<0.005
Benzene	0.5	<0.005
Carbon Tetrachloride	0.5	<0.005
Trichloroethylene	0.5	<0.005
Tetrachloroethylene	0.7	<0.005
Chlorobenzene	100	<0.005
1,4-Dichlorobenzene	7.5	<0.005

Table 3.4-26 Typical Estimated ZLD Solids Composition

COMPONENT	Wt. % (dry)
Calcium	0.02
Sodium	35.31
Magnesium	0.00
Potassium	0.04
Silica	0.06
Chloride	27.94
Total Sulfur	0.19
Sulfate	0.19
Fluoride	4.46
Total Inorganic Carbon	0.27
Ammonia Nitrogen	0.50
Sulfide	0.01
Thiosulfate	0.16
Thiocyanate	0.18
Total Phosphorus	0.01
Total Organic Carbon	6.02
Volatile Organic acids	21.34
Aluminum	0.01
Arsenic	0.04
Barium	0.00
Boron'	3.10
Cadmium	0.00
Chromium	0.00
Copper	0.00
Iron	0.01
Lead	0.00
Manganese	0.00
Nickel	0.00
Selenium	0.12
Silver	0.00
Strontium	0.00
Zinc	0.00
Total	100.00

3.4.4.2 Construction Wastes

The construction activity associated with the IGCC Power Station will also generate certain amounts of wastes. A preliminary estimate of hazardous and non-hazardous construction wastes is presented in Table 3.4-27. More significant temporary waste streams may include site clearing vegetation, soils, and debris, hydrostatic pressure-testing (hydrotest) water, used equipment lube oils, surplus materials, and empty containers.

Surplus and waste materials will be recycled to the extent practical. If feasible, removed site vegetation will be salvaged for pulp and paper production, or recycled for mulch. Hydrotest water will be reused for subsequent pressure tests if practical. Prior to disposal, used hydrotest water will be checked for contaminants and hazardous characteristics. Potential hydrotest water disposal methods, depending on the quality of the wastewater, include discharge to surface waters via the detention basin (pursuant to NPDES permits), trucking to a local POTW, or disposal at some other approved facility. Scrap and surplus materials and used lube oils will be recycled or reused to the maximum practical extent, or otherwise properly disposed.

Table 3.4-27 Estimated Construction Waste Streams (Phase I and II)

Waste Description	Comments	Approx Quantity Per Period	Likely Disposition
Hazardous or Non-hazardous Liquids			
Used lube oils, flushing oils		10 drums/mo	Recycle
Hydrotest water	One time during commissioning, reuse as practical, test for hazardous characteristics	1.2 million gallons (total Phase I and 2)	Hazardous – approved disposal facility Non-hazardous – drain to detention basin and release (need permit)
Steam turbine and HRSG cleaning wastes	Chelates, mild acids, TSP, and/or EDTA - one time during commissioning	700,000 gallons (total Phase I and 2)	Approved hazardous or non-hazardous disposal facility
Hazardous Liquids			
Solvents, used oils, paint, adhesives, oily rags	Containerize	200 gal/mo	Recycle or approved hazardous waste disposal facility
Hazardous Solids			
Spent welding materials	Containerize	400 lb/mo	Hazardous waste landfill
Used oil filters	Containerize	100 lb/mo	Hazardous waste landfill
Fluorescent/mercury vapor lamps		30 units/yr	Recycle
Masc. oily rags, oil adsorbents	Containerize	1 drum/mo	Recycle or Hazardous waste landfill
Empty hazardous material containers		1 yd^3/wk	Hazardous waste landfill
Used lead/acid and alkaline batteries	Separate and containerize	1 ton/yr	Recycle
Non-hazardous Liquids			
Sanitary waste from workforce	Portable chemical toilets	400 gal/day	Pumped and disposed by contractor
Non-hazardous Solids			
Site clearing - vegetation	Salvageable (?) timber and waste wood, brush, leaves and vegetative wastes	See Land Use/Land Cover Impacts for West & East Range Power Station Footprint	Sell salvageable timber for pulp and paper production, sell or donate waste wood for use as fire wood, mulch for recycle, or dispose in non-hazardous landfill.

Table 3.4-27 Estimated Construction Waste Streams (Phase I and II)

Waste Description	Comments	Approx Quantity Per Period	Likely Disposition
Site clearing – excavation of non suitable soils, masc. debris clearing	Stockpile soils on site	See Grading Plan Cut and Fill Estimates for West and East Range Grading Plans in Figure 3.2-3 and 3.2-5, respectively	Reuse soils for berms and landscaping, mulch and recycle organic debris, recycle or landfill inorganic debris.
Scrap materials, debris, and trash	Wood, metal, plastic, paper, packing, office wastes, etc.	40 yd^3/wk	Recycle or non-hazardous waste landfill

Construction management, contractors, and their employees will be responsible for minimizing the amount of waste produced by construction activities and will be required to fully cooperate with project procedures and regulatory requirements for waste minimization and proper handling, storage, and disposal of hazardous and non-hazardous wastes. Each construction contractor will be required to include waste management and waste minimization components in their overall project health, safety, and environmental site plans. Typical construction waste management measures will include:

- Dedicated areas and a system for waste management and segregation of incompatible wastes, with waste segregation occurring at time of generation.
- A waste control plan detailing waste collection and removal from the site. The plan will identify where waste of different categories will be collected in separate stockpiles or bins, and appropriate signage provided to clearly identify the category of each collection stockpile.
- Hazardous wastes, as defined by the applicable regulations, will be stored separately from non-hazardous wastes (and other, non-compatible hazardous wastes) in accordance with applicable regulations, project-specific requirements, and good waste management practices.
- Periodic construction supervision inspection to verify that wastes are properly stored and covered to prevent accidental spills and releases.
- Appropriately labeled waste disposal containers.
- Good housekeeping procedures. Work areas will be left in a clean and orderly condition at the end of each working day, with surplus materials and waste transferred to the waste management area.
- Appropriate waste management training for the construction workforce.

3.4.5 Liquid Waste Generation and Disposal

Information on liquid wastes is presented in Table 3.4-24 and 3.4-27 above.

3.4.6 Primary and Secondary Products

The primary product of the IGCC Power Station is electric power. The Project will also produce elemental sulfur and a vitreous inert slag. A world-wide market already exists for elemental sulfur, although its value will vary considerably with location, purity, and end use. No large scale market exists for slag at this time. It is expected that slag can be marketed for asphalt aggregate, construction backfill, or landfill cover applications. Slag with a carbon content of less than 5 percent by weight should be marketable as a higher value product such as roofing shingle applications. There is also a potential to market the slag produced from petroleum coke gasification for metals recovery. Excelsior conducted a preliminary market analysis for slag and sulfur that has been attached to this Application as Appendix 8.

3.4.7 Storage Requirements and Locations

Storage areas and requirements for the major process feedstocks and byproducts are shown in Table 3.4-28. The numbers are for each phase, with the total storage for both phases being double that reported in the table below.

Table 3.4-28
Feedstock and Byproduct Storage Requirements (Each Phase)

Material	Location	Storage Requirements
Coal Pile	Refer to Plot Plan	395,000 tons (5/45 day active/inactive storage based on maximum PRB-1 coal usage); Dust control; Water run-off control
Pet Coke Pile	Refer to Plot Plan	111,000 tons (5/45 day active/inactive storage; Dust control; Water run-off control
Flux Silo	Refer to Plot Plan	1,120 tons (5 day active storage)
Sulfur Tanks	Refer to Plot Plan	(~ 160 tons/day generated, based on Illinois No.6 coal)
Slag Pile	Refer to Plot Plan	32,265 tons (45 day storage, wet basis, using Illinois #6 coal)

3.4.8 Toxic and Hazardous Materials

Hazardous materials that will be used or stored for project operations include relatively small quantities of petroleum products, liquid oxygen and nitrogen, molten sulfur, catalysts, flammable and compressed gases, amine replacement and reclamation chemicals, water treatment chemicals, and minor amounts of solvents and paints. Materials and estimated quantities for the gasification/ASU blocks are based on experience at Wabash River. Power block requirements are estimated from similar combined cycle units. Catalyst materials such as those used in the COS Hydrolysis system and SRU are discussed in Sections 3.1.4.2 and 3.1.4.4, respectively. Spare catalyst may be selectively stored on-site.

Table 3.4-29 provides a list of potentially hazardous materials to be utilized and/or stored on-site. For the major bulk items, the approximate quantities expected to be stored on site are estimated, and may be adjusted as the frequency and methods of re-supply (railcar or truck) are optimized. Quantities shown are for Mesaba One and Mesaba Two, with individual phase quantities being approximately one-half of the total.

Table 3.4-29 On-Site Toxic and Hazardous Materials (Total For Phase I and II)

Material	Form	Quantity (Phases I and II)	General Location On-Site	Use
GASIFICATION/AIR SEPARATION UNIT AREAS				
BULK CHEMICALS				
Chlorine or Sodium Hypochlorite	Gas or Liquid	TBD		Cooling Towers
Sodium Hydroxide	Liquid	60,000 gal	Outdoor	Amine Reclamation and Sour Water Treatment
Potassium Hydroxide	Liquid	2,000 gal	Indoor	Dry Char Filter Cleaning
Water Treatment Chemicals	Liquid	Typ. Small (55 gal) Drums to less than ~ 500 gal tank	Indoor	Pump Bldg, Slurry Prep Bldg, Cooling Towers
Oxygen (95%)	Liquid	1,800 tons	Outdoor	ASU Backup Supply
Nitrogen	Liquid	5,000 tons	Outdoor	ASU Backup Supply
Molten sulfur	Liquid	200,000 gal	Outdoor	By-product for Sale
Ammonium lignosulfonate	Liquid	??	Indoor	Slurry Prep Bldg for maintaining % solids in slurry
MASC./DISTRIBUTED MATERIALS				
Paint/Thinners/etc.	Liquid	Minimal	Indoor	Shop/Warehouse
Lubrication Grease/Oils	Solid/Liquid	Minimal	Indoor	Pump Bldg, Slurry Prep Bldg., Shop/Warehouse
Compressed Gases (Ar, He, H_2)	Pressurized Gas	Minimal	Indoor	Lab
Chemical Reagents (acids/bases/standards)	Liquid	Minimal	Indoor	Lab
OTHER HAZARDOUS MATERIALS				
Flammable/Toxic Gases (H_2, CO, H_2S, SO_2)	Pressurized SynGas Mixture		Distributed	Process Piping/Vessels
Acetylene, Oxygen, other welding gases	Gas	Minimal (approved cylinders)		Welding
Natural Gas	Gas (high pressure)		Supply piping only	Startup/Backup Fuel
Diesel Fuel	Liquid	2,000 gal	Outdoor	Emergency generator/fire water pump fuel
POWER BLOCK AREA				
MASC./DISTRIBUTED CHEMICALS				
Sulfuric Acid	Liquid	12,000 gal	Outdoor	Cooling water and BFW pH control; battery acid
Sodium Hypochlorite	Liquid	20,000 gal	Outdoor	Cooling Tower biological control

Material	Form	Quantity (Phases I and II)	General Location On-Site	Use
Circulating Water Chemical Additives (e.g., Magnesium nitrate, magnesium chloride, 2-bromo-2-nitropropane-1,3-Diol, 5-chloro-2-Methyl-4-Isothizaoline-3-one) (Note 1)	Liquids	Typ. Small (55 gal) Drums to less than 500 gal tank	Indoor	Corrosion Inhibitor/ Biocides
Boiler Feedwater Chemicals, e.g., Carbonic Dihydrazide, Morpholine, Cyclohexamine, sodium sulfite (Note 1)	Liquids	Typ. Small (55 gal) Drums to less than 500 gal tank	Indoor	Boiler feedwater pH/Corrosion/ Dissolved Oxygen/Biocide control
Mineral Insulating Oil	Liquid	30,000 gal (estimated, to be confirmed)	Indoor	Electrical Transformers
Lubricating Oil	Liquid	21,000 gal (estimated, to be confirmed)	Indoor	Combustion Turbine/Steam Turbine/Masc. Equipment Lube Oils
Combustion turbine wash chemicals	Liquids	Intermittent use/ Chemicals not stored onsite/ cleaning by contractor		Combustion Turbine Generator cleaning
HRSG Cleaning Chemicals (e.g., HCl, Citric acid, EDTA Chelant, Sodium Nitrite) (Note 1)	Liquids	Multiyear cleaning requirement/ Temp storage only		HRSG Chemical Cleaning
Carbon Dioxide	Pressurized Gas	50,000 scf	Outdoors	Generator purging
Hydrogen	Pressurized Gas	29,000 scf	Outdoors (Assumes use of multi-tube trailer. Active volume based on 1 of 10 tubes per trailer)	Generator cooling (To be verified - Assumes use of H_2-cooled generators – dependent on selected manufacturer)

Notes: "Typical" chemicals for the application are identified.

Natural gas and syngas, which are flammable, will be used in the power block. Natural gas will be used as a startup or auxiliary fuel and will be utilized directly from the on-site pipeline (which connects to the off-site main pipeline). Natural gas will not be stored on site. Syngas will be the primary fuel for the combustion turbines. The syngas is a mixture of carbon monoxide, hydrogen, carbon dioxide, and water vapor. Gaseous hydrogen (H_2) will be used as a generator coolant. Hydrogen will be stored in pressurized gas tubes on a multi-tube trailer. The tube trailer will be stored outside near the turbine-generators and meet required building and fire codes. Carbon dioxide will be stored and utilized for purging of the generators after normal and emergency shutdowns.

Bulk quantities of liquid oxygen and nitrogen will be stored in tanks in the ASU to provide capacity for startups and continued plant operation during short-duration ASU system outages.

Other gases stored and used at the facility include those typically used for maintenance activities, such as shop welding, emission monitoring, and laboratory instrument calibration. These gases will be stored in approved standard-sized portable cylinders, and in appropriate locations.

Water treatment chemicals will be required and stored onsite. Bulk chemicals, such as acids and bases for pH control, will require storage in appropriately designed tankage with secondary containment and monitoring. Gaseous chlorine (used/stored in compliance with all applicable regulatory requirements) or hypochlorite bleach may be used for biological control of the various circulating and cooling tower streams.

Other water treatment chemicals will be required and used as biocides, pH control, dissolved oxygen removal, and corrosion control for boiler feed water (BFW), cooling tower and cooling water treatment. For raw water treatment, coagulants and polymers may also be used. Chemicals used for these purposes are generally specified by the water treatment provider, and are available under a number of trade names. Typical chemicals are identified in Table 3.4-19. Stored quantities of these materials are relatively small, ranging from 55 gal drums to 500 gal tanks.

Combustion turbine and HRSG washes are performed by contractors on an intermittent basis. Combustion turbines are cleaned by injecting wash water into the turbine for three to five minutes while cranking at full speed just prior to shutting down. The wash water is allowed to soak on the blades for required periods of time. Following the soak, the turbine is accelerated and rinse water is injected for 15 to 20 minutes. The turbine is then allowed to drain and dry. The process is repeated until rinse water exiting the drains is clear. The waste water is collected for disposal. HRSG finned tubes are cleaned with high pressure water jets. Waste water and deposits are drained from the bottom of the HRSG and collected for disposal. The chemicals required for the washes are usually provided by the contractors and are typically not stored long-term on site.

Diesel fuel will be used for the emergency generator and for the fire water pumps. The stored quantity is currently based on approximately 8 hours of operation of the diesel generator at full output (about 3 MW). This limited storage would require the Proponent to have contracts with fuel providers specifying that deliveries of diesel fuel be provided in less than 8 hours in the case of an emergency. Appropriate containment and monitoring for spillage control will be provided.

Other petroleum-containing hazardous materials include the combustion and steam turbine lube oils, steam turbine hydraulic fluid, transformer oils and miscellaneous plant equipment lube oils. These materials will be delivered in approved containers, stored in areas with appropriate secondary containment, and used within curbed areas that only drain to internal drains connected to an oil-water separator system. Oil reservoirs, containment areas, and the separators will be checked regularly to identify potential leakage issues and initiate appropriate actions.

3.4.9 Health and Safety Policies and Programs

Facility design features and management programs will be established to address hazardous materials storage locations, emergency response procedures, employee training requirements, hazard recognition, fire control procedures, hazard communications training, personal protection equipment training and accidental release reporting requirements. Significance criteria will be determined on the basis of federal, state and local guidelines, and on performance standards and thresholds adopted by responsible agencies. For example, the Project will comply with all applicable OSHA hazardous material requirements including the following specific OSHA regulations:

- 1910.120(q)(1) (Emergency Response Plan)
- 1910.120(q)(2) (Elements of Emergency Response Plan)
- 1910.120(q)(2) (Elements of Emergency Response Plan Decontamination)
- 1910.120(q)(2) (Elements of Emergency Response Plan: Personnel Roles)
- 1910.120(q)(2) (Elements of Emergency Response Plan, Critique of Response)
- 1910.120(q)(3) (Skilled Support Personnel)
- 1910.120(q)(6) (Training)
- 1910.120(q)(6) (Training - Hazardous Materials Technician
- 1910.120(q)(6) (Training - Hazardous Materials Technician - Implementation of Employer's Emergency Response Plan)

Basic approaches to prevent spills to the environment include the initial design of the Power Station Footprint, comprehensive containment structures, and worker safety and training programs. The comprehensive containment program ensures that appropriate tanks, walls, dikes, berms, curbs, etc. are used to accomplish effective containment. Worker safety programs will be established to ensure that workers are aware and knowledgeable of spill containment procedures and related health and environmental protection policies.

3.5 TRANSPORTATION INFRASTRUCTURE

3.5.1 Roadways

3.5.1.1 West Range Site

The West Range Site is located about 1.5 miles north of State Highway 169 (a four-lane east-west highway), about 0.4 miles to the east of Itasca CR 7, a two-lane highway running mostly in a north-south direction and about 0.25 miles north of an east-west stretch of CR 7. Other road corridors in the Project area include the Cross-Range Heavy Haul Road, a gravel road which has been in place for generations to allow heavy or slow loads to be transported between mines across the Iron Range. In the Project area, the Cross-Range Heavy Haul Road also serves as access to a small cluster of homes in the Big Diamond Lake/Dunning Lake area. The existing roadway system in the area of the West Range Site is shown in Figure 3.5-1.

3.5.1.1.1 Access Road 1

In discussing access to the IGCC Power Station with Itasca County, the County Engineer indicated the County's interest in re-routing the alignment of CR 7 to better serve local traffic patterns and the additional traffic related to the two large projects currently undergoing environmental review (the Mesaba Energy Project and the Minnesota Steel Industries, LLC project designed to produce sheet steel from taconite ore). This realignment of CR 7 would serve as the primary access road (hereafter "Access Road 1") to the IGCC Power Station, and would better handle heavy equipment and increased traffic volumes resulting from construction activities related to the two projects. The realignment would involve constructing a new two-lane roadway beginning at a new access point on State Highway 169, approximately 7,000 feet east of CR 7. The new road would cross underneath the adjacent rail line, proceed due north, then curve west between Big Diamond and Dunning Lakes before terminating in its connection with CR 7, just southwest of the Station Footprint.

Itasca County would construct and own Access Road 1. The County would seek to move the CR 7 designation to the new roadway and include it as part of the County's State Aid system. This would put all future maintenance of the road under the County's responsibility. The section of existing CR 7 between the plant and State Highway 169 would remain in place as either a lower level County Road, or turned back to the City of Taconite as a City street. The benefits to moving the designation would be to provide a better access point to U.S. Highway 169. The current intersection of CR 7 and State Highway 169 has poor visibility, relatively steep grades, and problems with slope stability. The IGCC Power Station would be served by one driveway off Access Road 1 (hereafter, the driveway off Access Road 1 or CR 7, as the case may be, will be termed "Access Road 2"). The proposed roadway system is shown in Figure 3.5-1.

Access Road 1 would be designed to meet Minnesota State Aid standards (the standards used by Minnesota cities and counties for the construction of roadways eligible for State funding). All alignments, horizontal curves, and clear zones would be designed for 55 miles per hour. A typical roadway cross section is shown in Figure 3.5-2.

Figure 3.5-1 Existing Highway System in the Vicinity of the West Range Site

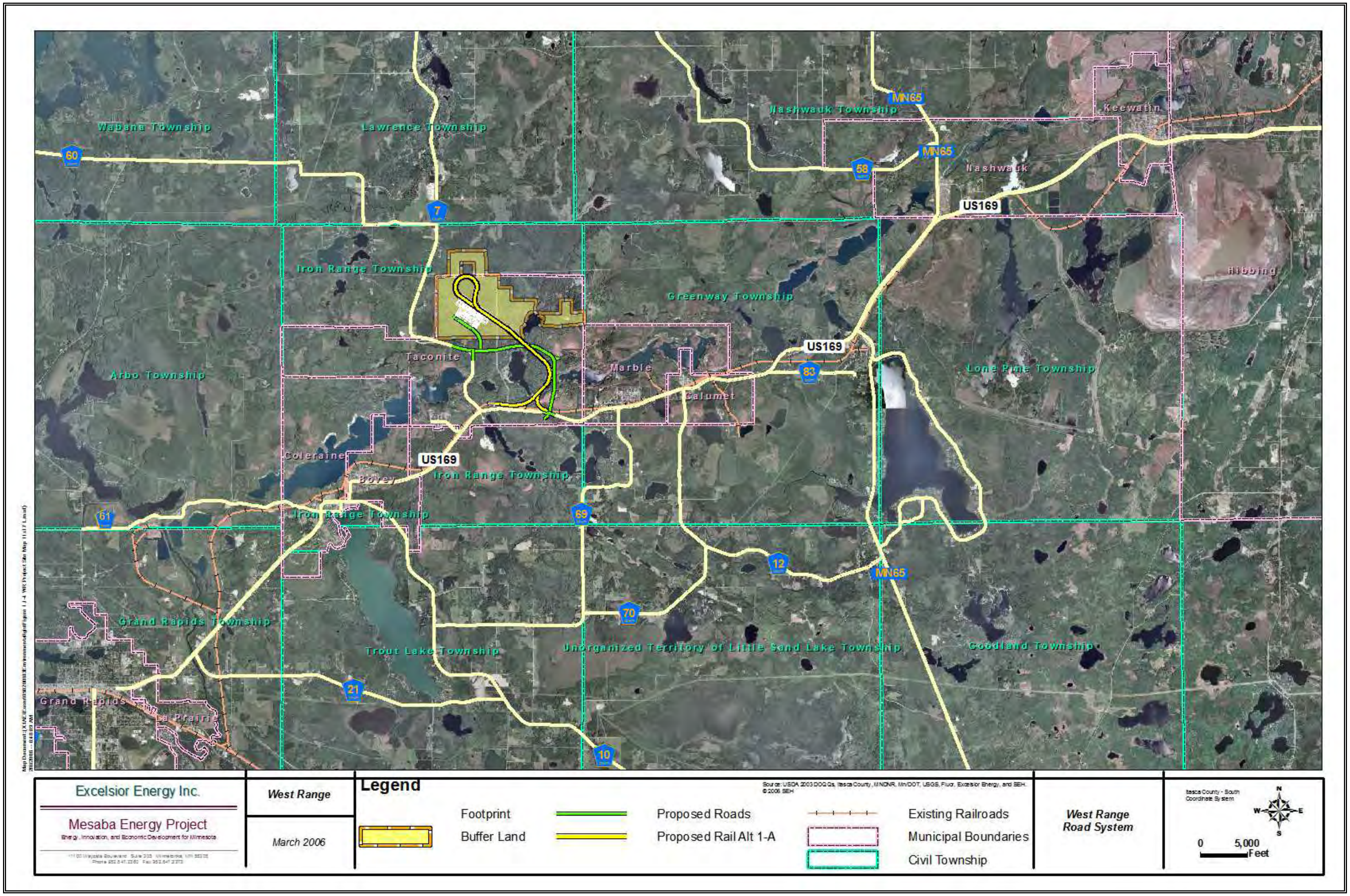
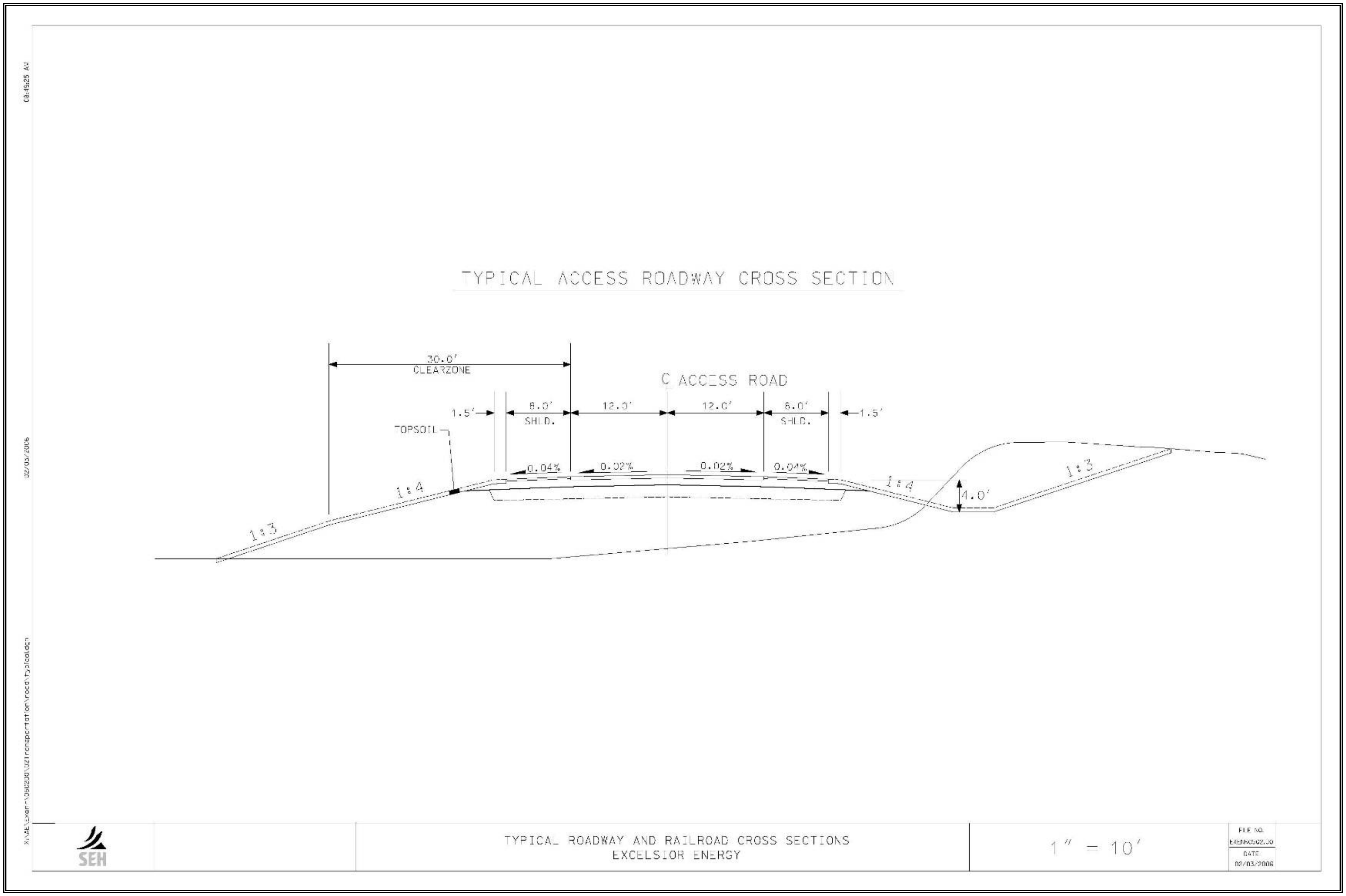


Figure 3.5-2 Cross Section of a Typical Access Road



If Access Road 1 is in place prior to construction of Mesaba One, all construction and plant employee traffic would use it to access the IGCC Power Station. However, it may be necessary, based on the timing of Itasca County's construction of Access Road 1, for the plant to be served by a driveway off existing CR 7 (a simple extension of Access Road 2) until Access Road 1 is completed.

The impacts associated with the County's construction of Access Road 1 have been fully studied and are included at Section 7.1.9.

3.5.1.1.2 Discussion

The connection to U.S. Highway 169 under either scenario (timely construction of the new access road or delayed construction) will require that both right and left turn lanes be constructed on Highway 169. A permit from the Minnesota Department of Transportation will be required to complete this work. Minnesota Department of Transportation staff has been involved in the discussions about the location of the new connection to Highway 169. The preferred alternative was selected after studying all potential options. Originally, there were discussions about providing access by simply adding driveways off CR 7 near the plant. After discussions with the County, this option was dismissed because of concerns about adding plant truck and passenger traffic to the poor intersection of CR 7 and State Highway 169.

Another option that was reviewed and dismissed was the upgrade of the Cross-Range Heavy Haul Road and connection of plant driveways from there. This option was abandoned because of the number of substandard horizontal and vertical curves on the haul road. In addition, it required utilization of the problem intersection of CR 7 and State Highway 169.

The preferred alternative connects to both CR 7 and State Highway 169, and provides the flexibility to have heavy equipment vehicles use either direction, which will be helpful when CR 7, U.S. Highway 169, or Access Road 1 are closed or reconstructed in the future.

A Traffic Volume Forecast Memorandum was completed for the West Range Site, the results of which are provided in Section 7.10.2. This Memorandum shows existing traffic volumes, as well as forecast volumes, during construction (2008) and the 20 years following plant construction (2028).

Only minor modifications will be required for the north-south segment of CR 7 (between State Highway 169 and the east-west segment of Access Road 1) to tie-in to Access Road 1. These modifications are discussed in Section 7.10.1. The proposed access roadway will be in place prior to peak construction activities of the plant, so there should be little impact to the existing system from the construction of the IGCC Power Station.

3.5.1.2 East Range Site

3.5.1.2.1 Regional Roadway System

The existing transportation system in the area of the East Range Site consists entirely of county roads. The nearest state highway is State Highway 135 that serves the west edge of Aurora, approximately 7 miles to the west. The primary county road in the area is CR 110 which connects with State Highway 135 in Aurora, then passes through Hoyt Lakes. CR 110 forms the western terminus of the Superior National Forest Scenic Byway. This Byway, also known as Forest Highway 11, has been recently constructed and serves to connect the North Shore of Lake Superior with the Mesaba Iron Range. The east-west section of CR 110 that runs through Hoyt Lakes parallels and is about 1.6 miles south of the southern boundary of the proposed East Range Site. The regional roadway system is shown in Figure 3.5-3.

3.5.1.2.2 Access to the East Range Site

In order to access the East Range Site, traffic approaching from the west will travel on CR 110 and turn north onto CR 666 at the first major intersection in Hoyt Lakes. This intersection is controlled as a four-way stop. CR 666 travels to the north about 1.6 miles where it adjoins the eastern boundary of the East Range Site for a distance of about 1.4 miles. CR 666 continues beyond the East Range Site a distance of about 2.1 miles further north-northeast to the Cliffs-Erie administration building.

Traffic approaching Hoyt Lakes from the east will be traveling on CR 110, turn north onto Hampshire Drive at the first major intersection upon coming into town, travel about 0.3 miles, and turn northeast onto CR 666 toward the site.

On August 10, 2005, President Bush signed into law Public Law 109-59, which authorized $2.4 million for construction of a new highway between the bridge over the Partridge River on County Road 565 in Hoyt Lakes to the intersection of Highways 21 and 70 in Babbitt. This project will create a feasible option for approaching the Hoyt Lakes area from the north. Previously, the only approach from the north would have been a circuitous trip south on State Highway 135. Once in Hoyt Lakes, traffic would approach the site as described above.

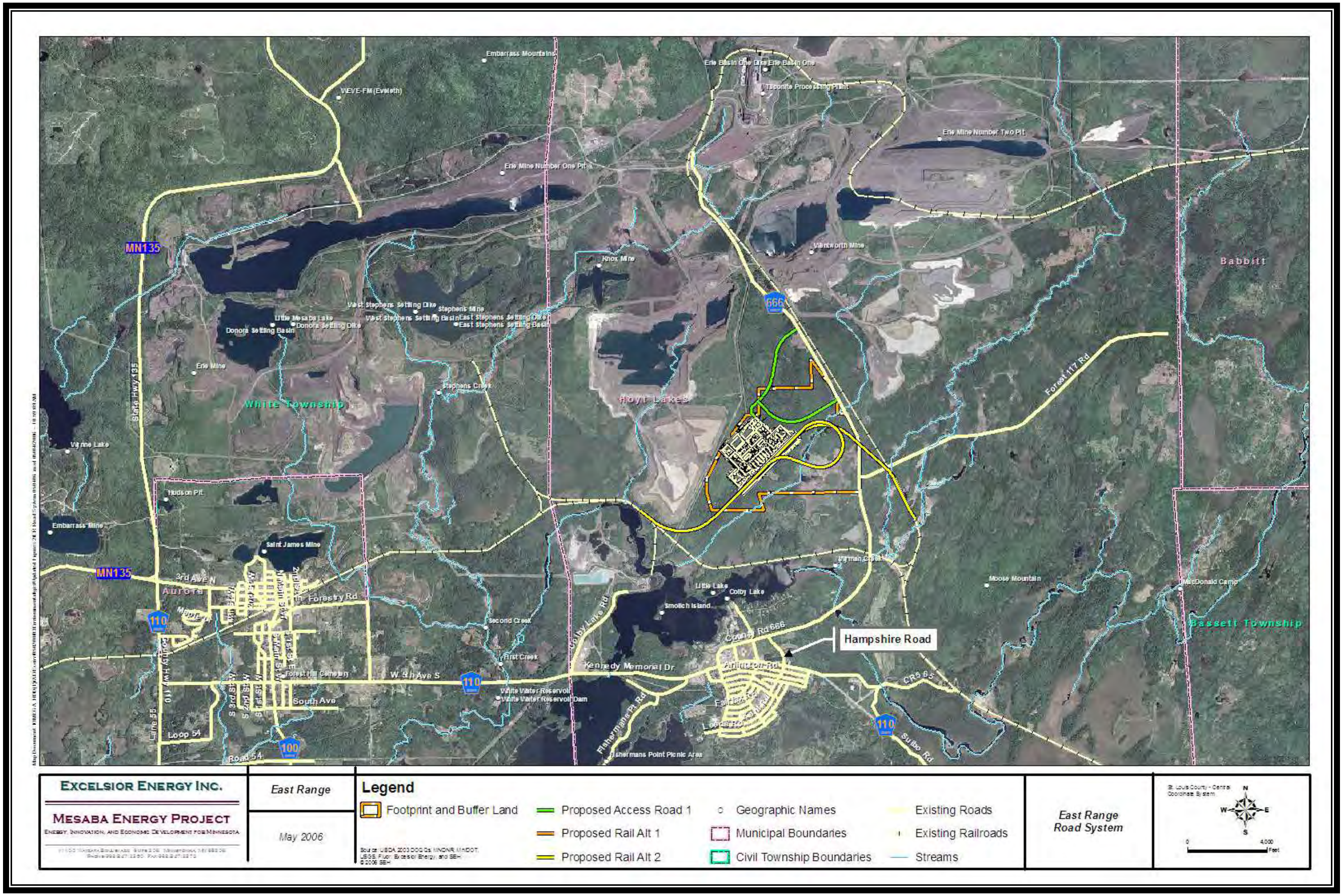
3.5.1.2.3 Access Road 1

CR 666 passes just to the east of the proposed site and is the only feasible option to serve the site via the public road system. Proposed Access Road 1 consists of a loop roadway to serve the IGCC Power Station from County Road 666. This loop will have two access points onto CR 666 and was designed to provide gentle curves, good sightlines, minimal impacts to wetlands, and avoidance of the historic drilling site to the east of the plant.

Traffic will enter the site from the north access point. During construction and other periods of peak volumes, traffic will exit the site at the south access point. After the IGCC Power Station assumes normal operations and traffic patterns have been established, traffic may be allowed to exit the Station from either access point. Having two access points off CR 666 will also provide flexibility in accessing the Station during construction of Access Road 1 and in the future when maintenance or construction work is performed on CR 666.

Easements would be required over lands currently owned by St. Louis County and a minimal number of private parties.

Figure 3.5-3 Regional Roadway System in Vicinity of East Range Site in Relationship to Proposed Access Road 1



3.5.2 Rail

The Project will require coal and other materials to be delivered to the Project Sites by train. The BNSF Railway (the Burlington Northern Santa Fe Railroad changed its official corporate name in the spring of 2005 to the BNSF Railway, hereafter "BNSF") and the Canadian National Railroad ("CN") are the two predominant rail providers in the region serving the West and East Range Sites (the CN purchased the Duluth Mesabi & Iron Range Railroad in 2003). A map of the rail trackage owned and operated by these two entities in the Project vicinity is provided in Figure 3.5-4.

An important element in the site selection process was whether a site could be served by more than one rail provider via their own trackage. Having such capability would provide consumers with more competition and flexibility in the fuel supply equation, and should result in lower fuel costs over the life of the Project.

3.5.2.1 Site Independent Project Elements

3.5.2.1.1 Feedstock Deliveries

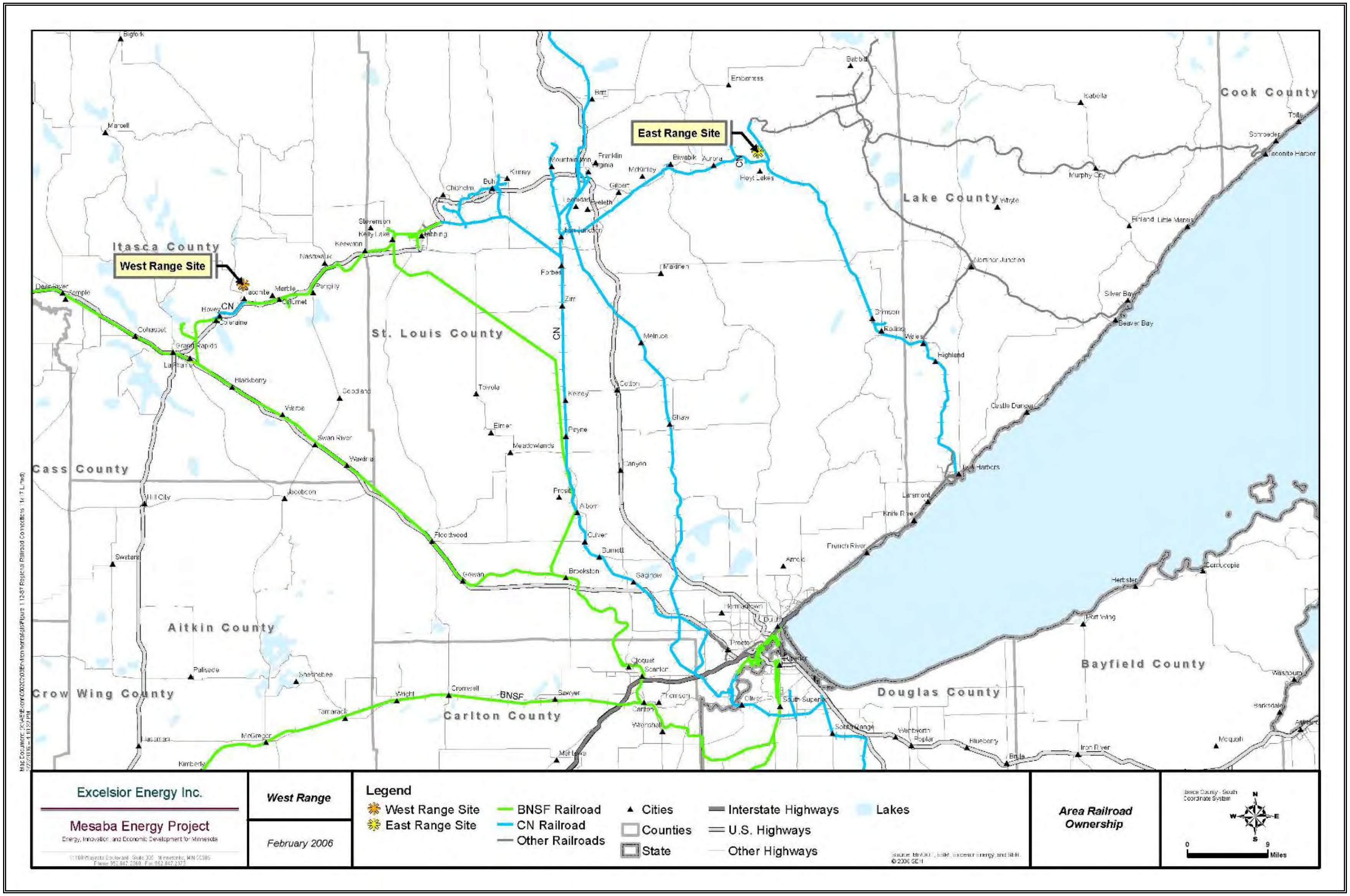
Coal is the most significant commodity that will be delivered to the Project Sites. Delivery of coal under peak operation and material handling operations are discussed in Sections 3.1.1 and 3.4.1.1.5. Table 3.5-1 presents the variation that could be expected in coal deliveries under the best and worst case conditions as a function of the feedstock consumed.

Table 3.5-1
Projected Coal Deliveries to the West Range Project Site

COAL CONSUMED	PEAK USE (TPD)	UNIT TRAIN DELIVERIES (RND TRIPS/WEEK)[1]	
		WORST CASE	BEST CASE[2]
Sub-Bituminous (Powder River Basin)	8,550	4-5	3-4
Bituminous (Ill. No. 6)	6,120	3-4	2-3
Sub-Bituminous/Pet. Coke Blend (50:50)	6,450	3-4	2-3

1. Phase I IGCC Power Station deliveries; number of deliveries for Phase I and II Power Station would double.
2. Best case conditions represented by 135 car unit train with 119 tons per car or about 16,070 tons per unit train.

Figure 3.5-4 BNSF and CN Rail Trackage Operated in the Project Vicinity



Rail cars arriving via unit trains will be unloaded using a state-of-the-art rapid discharge rotary dumper with an automatic railcar positioner. The rail loop and positioner allow a full-length 8,000-foot long coal train (a 135 car unit train) to be pulled through the site without uncoupling any of the cars. Each rail car would be rotated upside down inside the rotary dumper building to unload the coal. The dumper building would be enclosed and maintained under negative pressure during the unloading process to minimize fugitive emissions. Design of the dumper building's dust control system is further described in Section 3.4.1.1.5.

Each unit train would take approximately 4 hours to unload. The impact of peak unit train rail deliveries on local traffic is discussed in Sections 7.9.7 and 8.9.

Other incoming materials using train delivery could include petroleum coke, slag, flux, and construction materials and equipment. Construction deliveries would likely total two trains per week. Outgoing trained material would likely include elemental sulfur, the source of which would be hydrogen sulfide in syngas produced by the gasifier. Depending upon the fuel being used, the Phase I IGCC Power Station would produce between 500 and 800 tons per day of slag, a black, non-hazardous, glass-like material that may have industrial uses. Also, depending upon the fuel being used, the Station would produce between 30-165 tons per day of elemental sulfur that may be sold and/or transported off site.

There are three major design criteria essential for a unit coal train unloading facility. The first is the length of track. A 135 car unit coal train, about 8,000 feet in length, must be completely clear of the mainline track during the unloading operation. The second major design consideration involves the maximum degree of curve. A rail track curve greater than six degrees will have higher levels of track maintenance and may cause problems for the computer guided unloading system. Third is the issue of track profile grade. During the unloading operation, the computer-guided system will control the movement of the train. To facilitate the use of such computer-guided systems, it is important that the track be level as 135 car unit trains will weigh some 20,000 tons. Track grades in non-unloading areas also need to be restricted to the ruling grades on the mainline tracks.

A Railroad Design Guideline based on BNSF and CN unit train standards was developed to formalize site selection criteria and identify major considerations in site layout. The minimum acceptable curvatures, grades and turnout size specified in the Guideline are presented in Table 3.5-2.

Finally, connecting the BNSF and/or CN with the IGCC Power Station on the West or East Range Project Sites requires approvals from each of those companies, but does not require other public approvals.

Table 3.5-2
Railroad Design Criteria for Phase I: West and East Range Sites

ATTRIBUTE	PREFERRED CRITERIA	MAXIMUM CRITERIA
Train size, cars per unit train	115	135
Coal per car, tons	119	
Train length, feet	6,600	7,700
Maximum grade approach track	0.3 %	0.4 %
Maximum grade on unloading track	0.00%	0.1%
Maximum grade on coal train tracks	0.5 %	1.0%
Maximum curvature, empty coal train	5° (1,146ft. radius)	6° (955 ft. radius)
Maximum curvature, loaded coal train	2° (2,865 ft. radius)	3° (1,910 ft. radius)
Maximum curvature, plant tracks	7.5º (764 ft. radius)	9.5º (603 ft. radius)
Public grade crossings	None allowed in unloading areas	

3.5.2.2 West Range Site

3.5.2.2.1 General

The proposed IGCC Power Station Footprint for West Range Site is located approximately 1.5 miles north of the mainline tracks of the BNSF and CN (see Figure 2.1-3).

Historically, the BNSF and CN railroads had their own mainline tracks throughout the area around Grand Rapids, Minnesota. In the 1960s, the BNSF and CN railroads combined their regional operations to a single track. The BNSF currently owns most of the 80 mile track from Gunn (an unincorporated "railroad town" located immediately east of La Prairie, MN) to Brookston (near Carlton, MN), except for a 4.5-mile portion of track beginning about 0.5 mile east of CR 7 and west to Bovey. The location of this section of track is shown in Figure 3.5-6. A detail of the eastern boundary of CN's ownership point is provided in Figure 3.5-7. Since railroads are restricted from originating or delivering traffic from another railroad's line, even though many share each other's tracks, this short section of rail track owned by CN allows it direct access to the West Range Site (the mechanism allowing such access is discussed in the section below titled "CN Rail Deliveries"). BNSF deliveries of coal to the West Range Site can only originate east of the ownership boundary shown in Figure 3.5-7.

Figure 3.5-5 Typical Cross Section of Rail Track Meeting Design Guideline

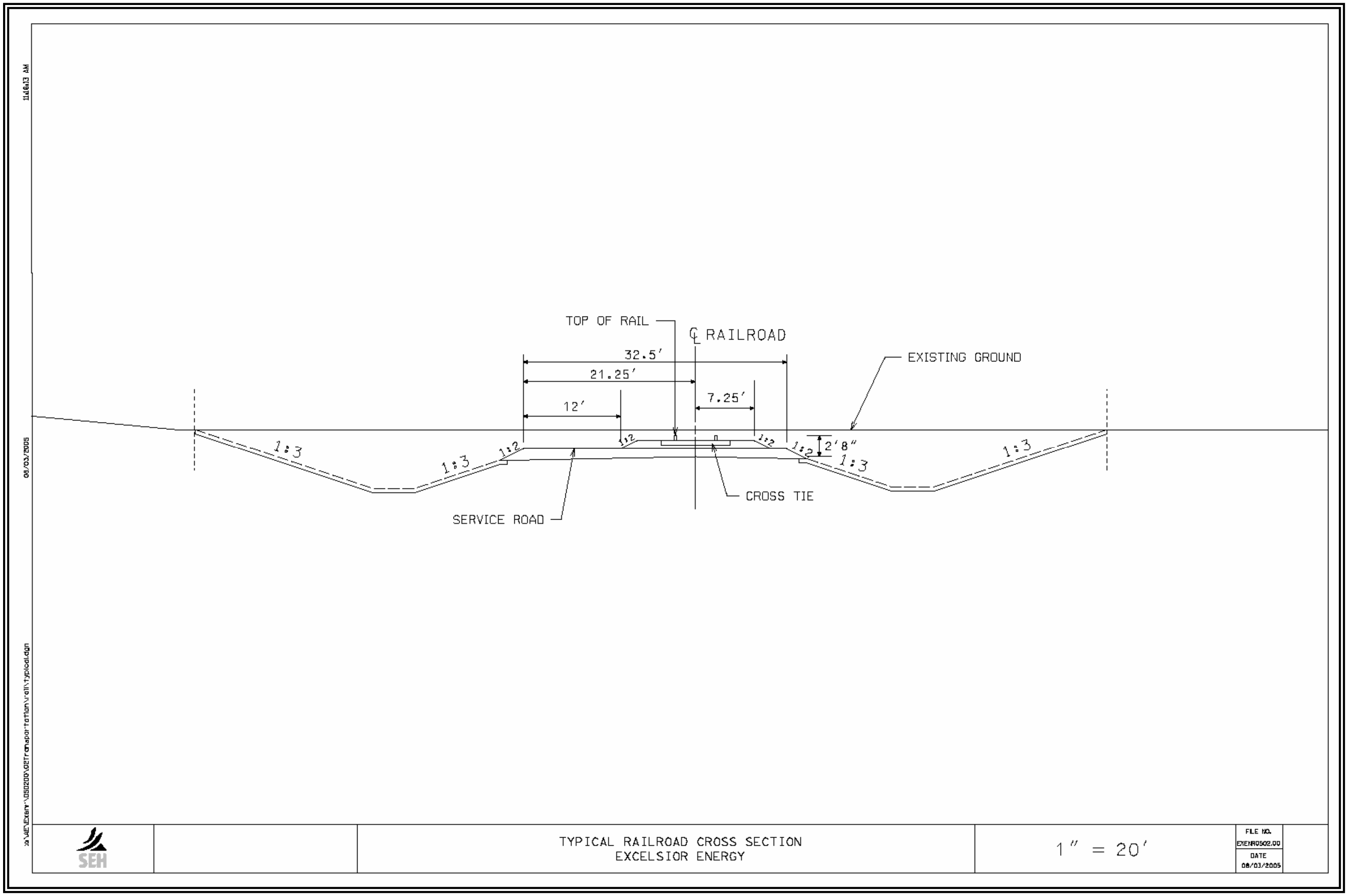


Figure 3.5-6 Regional Railroad Tracks Showing 4.5 mile Section of Track Near West Range Site Owned by CN

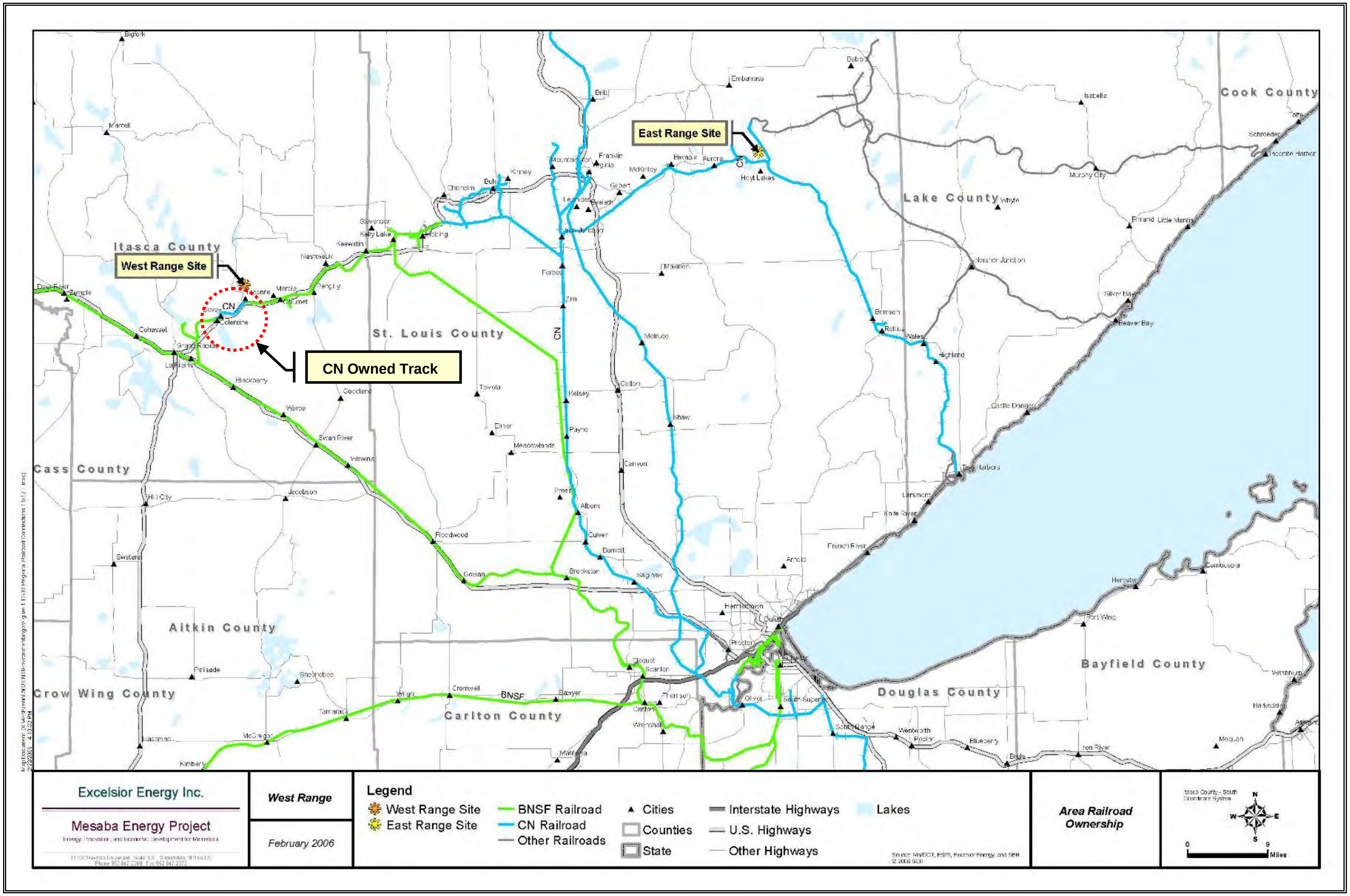
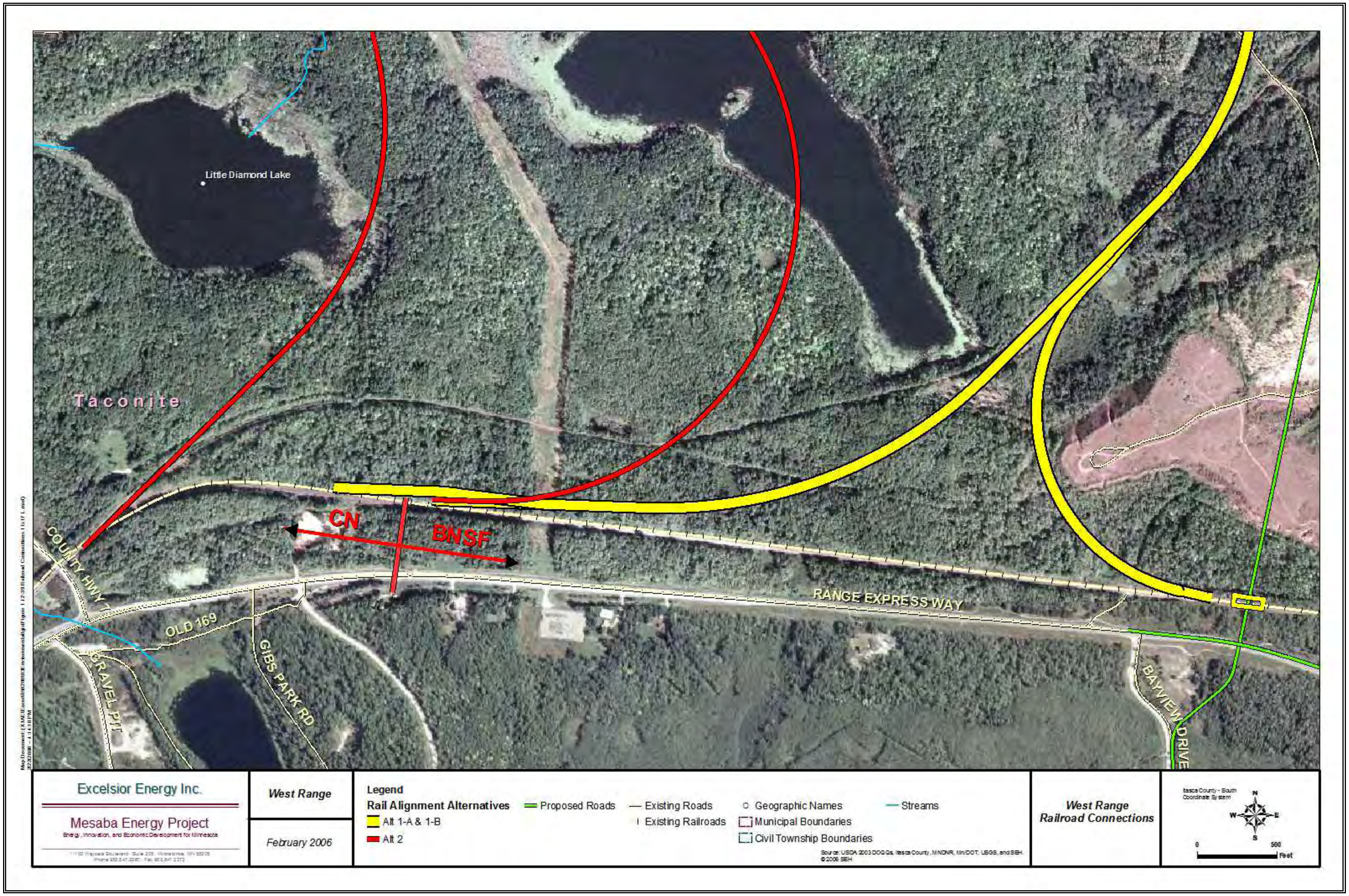


Figure 3.5-7 BNSF and CN Ownership Boundary Near the West Range Site



3.5.2.2.2 BNSF Rail Operations in the Project Vicinity

The shortest route for delivering coal from the Powder River Basin to the West Range Site is via the BNSF trackage across North Dakota. The preferred route would pass through Fargo, ND, north to Grand Forks, ND and across Minnesota through Grand Rapids to Gunn and then to Taconite. About six trains per day currently travel on the BNSF line through Grand Rapids at speeds up to 25 mile per hour. Traveling at 25 miles per hour, a unit coal train would take approximately three to four minutes to clear each grade crossing. Nine grade crossings (a location where a public highway, road, street, or private roadway, including associated sidewalks and pathways, crosses one or more railroad tracks at grade) are located within the city limits of Grand Rapids and La Prairie.

The track from Gunn to the West Range Site (about 12.5 miles in length) also operates at speeds of 25 miles per hour and has traditionally carried 4 to 10 trains per day. This track segment has another six public grade crossings.

An alternate route to the West Range Site via BNSF trackage would be from Brookston northward to Kelly Lake and Keewatin and westward to the plant site. This alternate route is illustrated in Figure 3.5-8. This route would also have a speed limit of 25 miles per hour and would primarily be used for non-coal train operations. Use of this route by unit coal trains would add over 100 miles to the trip in each direction and would require the trains to ascend a significant grade north of Brookston. Unit coal trains would only use this route if there were a major track problem east of Gunn. If this were the case, BNSF trains would access the West Range Site using the east “Y” trackage. Although the 5º curvature of the east “Y” track is outside the design criteria for unit coal trains presented in Table 3.5-2, this trackage could support occasional unit train deliveries of coal.

3.5.2.2.3 CN Rail Deliveries

The CN delivery of PRB coal would be from the Superior, WI area northward to Virginia and then west past Hibbing and Keewatin to Taconite/Bovey. The CN trackage within this route is shown in Figure 3.5-9. CN unit coal trains would access the West Range Site by approaching from the east, travel past the site, and either back into the Site, or stop in Bovey, disconnect the locomotives from in front of the train, and reconnect to the end of the train, thereby accessing the Site from the west.

A reverse move by the CN would be required for the empty train. To accommodate such maneuvers, unit coal trains supplied by CN would use an existing siding in Bovey that would need to be lengthened. Other CN deliveries to the plant would occur via the same type of movement, but with much shorter trains. Neither CN unit train movements nor non-coal movements required to access the West Range Site in the manner described would block any public grade crossings near the site.

Figure 3.5-8 Alternative Routes for the BNSF to Serve the West Range Site

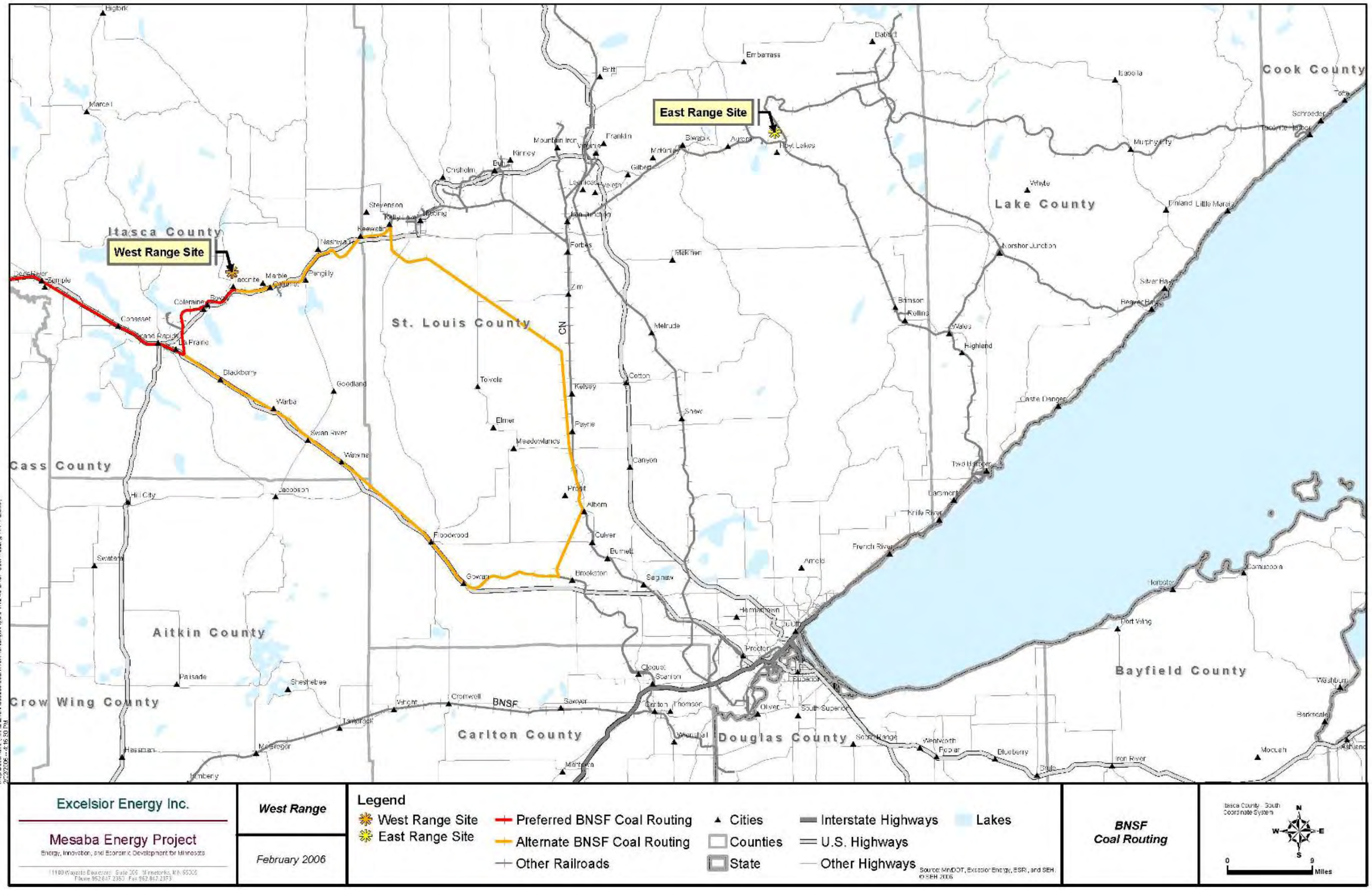
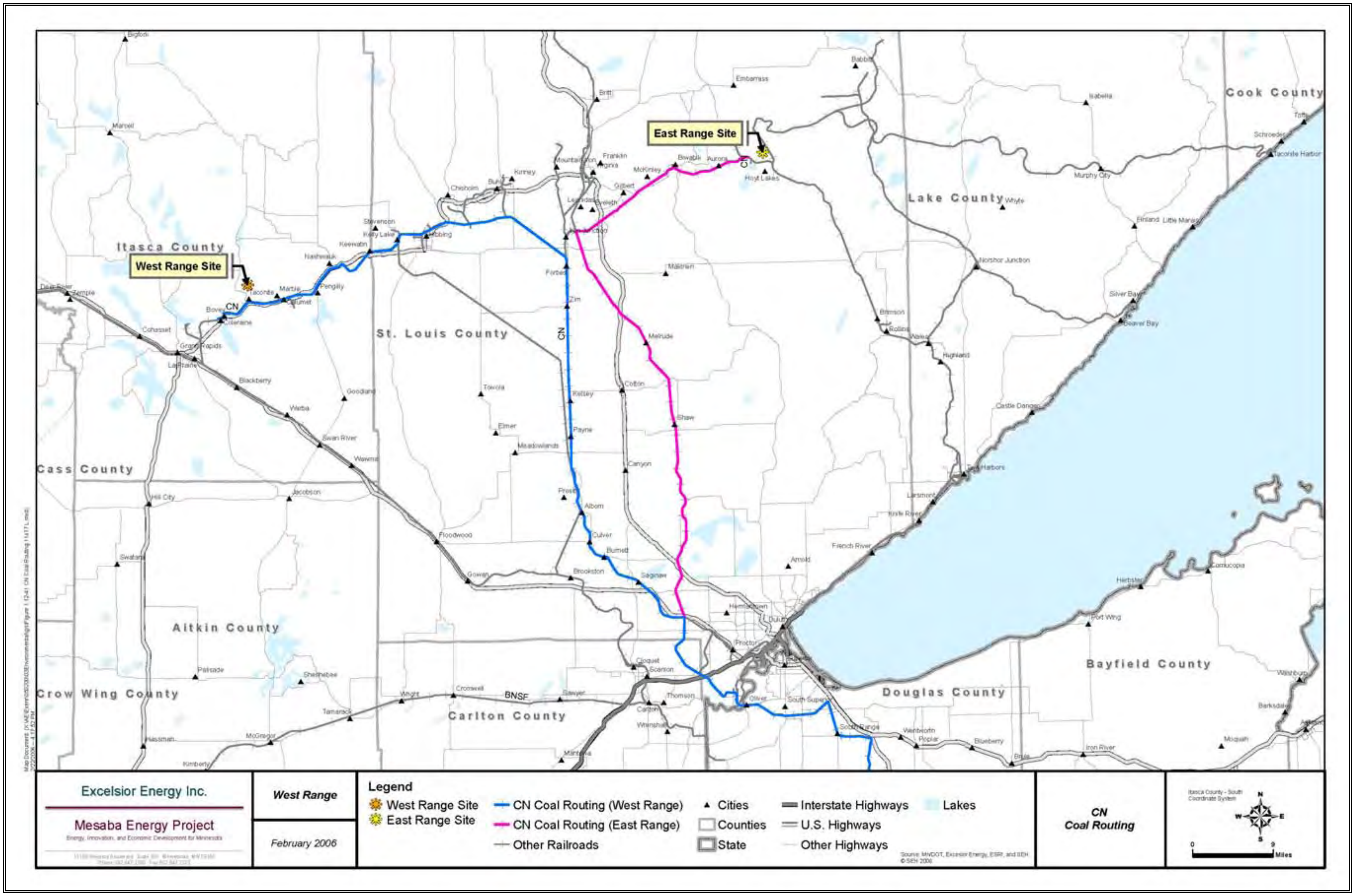


Figure 3.5- 9 Alternative Routes for the CN to Serve the West Range or East Range Sites



The short length of CN track near the West Range Site is temporarily out of service because of rising water levels in the CMP. Since the cessation of mining, the CMP has continued to fill with water and as of May 2005, the sloughing of bank material separating the current CN track through Bovey from the steep edge of the mine pit has decreased in distance from 100 feet to 50 feet (a useful discussion about the rising water levels and their effect on rail traffic can be found at the following link: http://www.mepartnership.org/mep_whatsnew.asp?new_id=756). The Mesaba Energy Project would greatly rectify this circumstance by lowering water levels in the CMP, thereby enhancing the ability to make use of the CN track (CN has determined that repairs to this line were not appropriate in the absence of a long term solution to keep water levels from rising). At the request of the BNSF or another local shipper, the track would be required to be placed back in service under current common carrier regulations of the Surface Transportation Board (an agency of the US Department of Transportation that regulates railroad service and provides a forum for rate and service disputes).

3.5.2.2.4 Alternatives

3.5.2.2.4A Introduction

The major issues involved with providing railroad access into the West Range Site include following: site elevation/topography relative to that of the existing trackage; avoiding undue impacts to Big Diamond and Dunning Lakes; avoiding mine dumps (locations where soils and rock overlying natural resources that have been mined have been permanently placed, such historical placement often not subject to rules governing reclamation) and pits; and rail connection and operational issues. In considering these elements, three rail alignments were identified and evaluated. These alternatives were initially deemed to be viable and all appeared to have a reasonable chance to meet prescribed engineering criteria. However, during subsequent detailed review, Alternative 2 proved to be compromised from both engineering and environmental perspectives and was dropped from further consideration. The detailed review process is discussed in the section below titled “Alternative 2.”

3.5.2.2.4B Alternative 1

Figure 3.5-10 illustrates the general plant site area relative to the location of the existing rail lines and identifies the additional trackage needed to access the Phase I IGCC Power Station under Alternative 1. This alternative includes a rail corridor that would allow access to the IGCC Power Station from the west by both BNSF and CN unit trains. The eastern approach would normally be used by the BNSF for delivering materials other than coal. Unit coal trains would only use the eastern approach in the situation where a western approach was unavailable.

Two miles of new track would be constructed between the existing mainline track and the boundary of the Buffer Land. An additional four miles of new track would be constructed to form a portion of the rail loop lying within the Buffer Land.

Two different alignments were evaluated as part of Alternative 1. As shown on Figure 3.5-10, the alignment for Alternative 1-A bifurcates from the existing CN and BNSF main lines that run parallel to Highway 169 and then turns to the northwest between Big Diamond Lake and Dunning Lake. The alignment for Alternative 1-B, also shown in Figure 3.5-10, would split from the CN and BNSF rail lines in the same location, but instead of diverting northwest between Big Diamond and Dunning Lakes would continue running north on the east side of Dunning Lake and, once north of the lake, would run west to the proposed IGCC Power Station

Footprint. Both Alternatives 1-A and 1-B would include a loop to the north of the proposed facility and in both instances the coal trains would exit via the same route of entry.

The alignments for Alternatives 1-A and 1-B meet the general design criteria provided in Table 3.5-2 and can accommodate access by two rail service providers. Acceptable curve radiuses require that the track alignment be directed east of Big Diamond Lake. The new alignment south of Big Diamond Lake generally follows an old railroad grade around the southern tip of the lake. In order to avoid a large mine dump, Alternative 1-A turns to the northwest to follow a new corridor between Big Diamond Lake and Dunning Lake. To provide an acceptable grade for the Alternative 1-A track requires filling low areas located between the two lakes and cutting from terrain obstacles into the proposed Facility. The rail loop for Alternative 1-A will be mostly on a fill section.

Alternative 1-B follows the same alignment as 1-A for the first 6,000 feet but then heads due north and to the east of Dunning Lake. At a point north of Dunning Lake, Alternative 1-B curves 90º to the west and follows a straight line to the Station Footprint. To provide an acceptable grade for the Alternative 1-B track requires cutting through a large mine dump east of Big Diamond Lake and Dunning Lake, passage through a large wetland area on the north east corner of Dunning Lake, and significant additional contouring on-route to the rail loop. The rail loop would be mostly on a fill section.

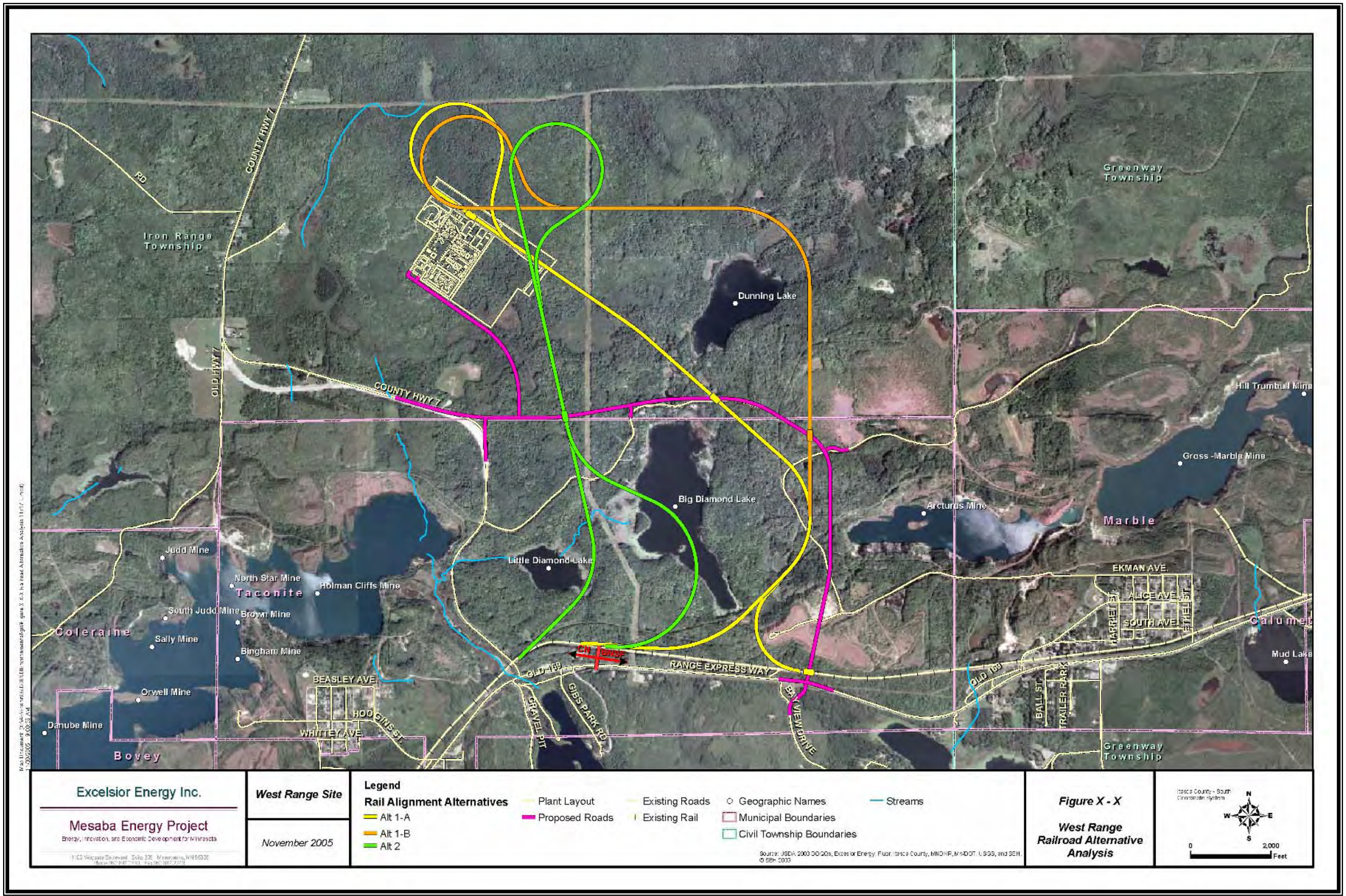
Alternative 1-A will be situated within 400 feet of one four-season residence located north of the track near Dunning Lake. Alternative 1-B is about 1,200 feet from this residence. The closest residence on Big Diamond Lake is about 700 feet from the proposed track. Section 7.9.7 addresses the general noise and vibration impacts in the vicinity of the West Range Site and on these properties in particular.

Both Alternatives 1-A and 1-B would meet acceptable alignment, grade, and rail operations criteria. The length of rail line required for construction of these alternatives would total approximately six and seven miles, respectively. A rail bridge over the new access roadway to the West Range Site would be constructed to avoid crossings that could cause major traffic interruptions close to the IGCC Power Station. Existing roadways that would be affected by the rail spur into the Station Footprint are forest roads that can be re-routed without causing major traffic disruptions. The traffic impacts associated with such changes are discussed in Section 7.10.2.

The alignment for Alternative 1-B would result in greater impacts to wetland areas, would place the rail dumper building in the wrong part of the Buffer Land (requiring coal to be conveyed across a significant distance to the IGCC Power Station), and would require more significant earth removal work (as the route would cut across several large mine dumps and existing terrain features). The only practical benefit this alignment offers over Alternative 1-A is that it would divert rail traffic away from the small number of residential properties located on Big Diamond and Dunning Lakes. Alternative 1-A would require easements over or acquisition of some additional private property. Wetland impacts for each alternative and mitigation requirements are discussed in detail in Sections 7.7.11 and 7.7.12. Table 3.5-3 presents a summary of these impacts for the two alternatives.

Excess soil from cuts will be used as fill as detailed in Section 3 of the ES.

Figure 3.5-10. Alternative Rail Layouts Evaluated for the West Range Sites



Alternatives 1-A and 1-B were judged to be similar with regard to roadway impacts. Both alternatives would have a surplus of cut/fill material that would need to be disposed of near the Station Footprint. Alternative 1-A is deemed to be superior to Alternative 1-B for the following reasons:

1. Less impact to wetlands
2. Avoids an area of high probability of historic artifacts near Dunning Lake (see Section 7.11.2.1)
3. Better alignment of the curves
4. Lower cost

Table 3.5-3
Railroad Alternatives Analysis

	Alternative 1A	Alternative 1B	Alternative 2
Total length of track (miles)	6.0	6.9	4.5
Length of track outside of Buffer land (feet)	15,900	19,000	9,000
Train speed (mph)	10	10	10
Maximum grade	0.30 %	0.35%	0.40%
Maximum Curvature (loaded coal train)	2 degrees 30 minutes	3 degrees	3 degrees
New right-of-way (acre)	35	43	20
Largest cut (ft)	65	120	*
Largest fill (ft)	25	25	*
Approximate cut Qty (cu.yd.)	3,000,000	8,500,000	*
Approximate fill Qty (cu.yd.)	2,000,000	2,000,000	*
No of residences within 1000 feet	3	0	0
Closest residence (FT)	400	2,000	1,200
Acceptable alignment	Yes	Yes	No
Comments	Preferred		Discarded

*Was not computed because alignment was unacceptable.

<u>West Range Rail Line Alternative 2</u>

The Company evaluated the possibility of accessing the West Range Site via a rail corridor that would split from the existing CN rail line at a point due south of Little Diamond Lake as shown on Figure 3.5-10 and run north between Little and Big Diamond Lakes. This alternative would include a loop to the northeast of the Station Footprint as in Alternative 1 and allow CN unit coal trains to exit via their same route of entry. There would be a slight impact to Little Diamond Lake on the southeast corner.

The BNSF would not be able to originate a shipment using the CN trackage that would be constructed as part of this alternative rail supply option. Instead, BNSF shipments would be required to originate from a point west of the proposed CN rail spur and southwest of Big Diamond Lake. This origination point would require a sizable portion of Big Diamond Lake to be filled to maintain acceptable curvatures as per the Railroad Design Guideline. Figure 3.5-10 shows that the amount of filling required to allow BNSF to access this route from the west would be prohibitive.

The BNSF access from the east would require coal trains to be routed an additional 100 miles through Carlton. The disadvantages to this routing have been discussed earlier in the Section labeled "BNSF Rail Operations in the Project Vicinity." Additional track work, including a railroad diamond for the Minnesota Steel project, would also be required (a railroad diamond is where two tracks cross each other at the same elevation; such diamonds are difficult to maintain and are to be avoided if possible).

An additional alternative provided the CN access from the west side of Big Diamond Lake and the BNSF access from the east side of the Lake. This too was discarded because of duplication of tracks, direction difficulties relative to the position of the coal dumper, impacts to a much larger area around Big Diamond Lake, and the same impact to residents as Alternative 1-B.

Alternate 2 is not acceptable from railroad engineering, environmental impact, and cost perspectives, and has been eliminated from consideration.

3.5.2.3 East Range Rail Line Alternatives

3.5.2.3.1 Alternatives

3.5.2.3.1A Introduction

The proposed East Range Site does not provide for the option of immediate competition between rail providers. The nearest competitive railroad to the CN is the BNSF Railway near Hibbing, 40 miles from the East Range Site. The CN will be the only feasible near-term rail service provider into the East Range Site. Longer term, it may be possible to utilize the port at Taconite Harbor and CE's privately own railroad to provide feedstock to the East Range Site, but for now, this option is considered uneconomic.

The East Range Site is located approximately one mile north and one mile west of two CN tracks. The east-west track runs from Eveleth, Minnesota to Two Harbors, Minnesota. The north-south track connects with the east-west track at Wyman Junction (about 1.7 miles southeast of the boundary of the Buffer Land) and extends northward to Embarrass. Coal would be delivered by other railroads to the CN at either Superior, Wisconsin or to a railroad yard south of Eveleth, Minnesota. The CN would deliver coal to the site from Eveleth as shown in Figure 3.5-9. Empty unit trains would return by the same route. The layout of the proposed rail alignments are presented in Figure 2.1-5.

The CN operates daily on the track servicing Laskin, CE, and several proposed and existing industrial customers.

Existing roadways that would be affected by the rail spur into the Site are forest roads that can be re-routed without causing major traffic disruptions. The traffic impacts associated with such changes are discussed in Section 7.10.2.

The East Range Site is divided between upland and wetland areas. Most of the southern area is wetland. The railroad loop will impact this wetland area and the most significant rail routing issue of the site is to maintain the rail elevation high enough to minimize wetland impacts, but low enough to achieve acceptable grades. The wetland elevation is about 1,470-1,475 ft msl.

The Railroad Design Guideline presented in Table 3.5-2 was used to identify and avoid major flaws in the East Range Site rail alignments. A typical track section consistent with the Design Guideline was illustrated in Figure 3.5-5.

3.5.2.3.1B East Range Rail Line Alternative 1

Alternative 1 is a traditional coal loop that will handle a complete coal train and allow return in the same direction. The track would start near MP's Syl Laskin Generating Station spur and travel east northeast to the Station Footprint. The track would be about 17,800 feet long plus additional plant track for miscellaneous chemicals and products. The track would begin at about elevation 1,455 ft and the coal loop will be at set at about 1,465-1,470 ft.

No residential dwellings are located near the proposed track but some wetland mitigation would be required. The track is near the base of a waste rock dump that may require special treatment to avoid sloughing onto the rail track.

3.5.2.3.1C East Range Rail Alternative 2

Alternative 2 is an alignment that would handle a complete coal train, but would cross the Buffer Land (rather than looping within it) and connect with the CN north-south track just north of Wyman Junction. This track would be about 18,500 feet long and have the coal dumper centered in the middle. The train would leave the track at an elevation of 1,455 ft, climb to a dumper elevation of about 1,465-1,470 ft. and continue to climb to the about 1,485 ft at the north-south CN track. To maintain a workable grade, this track would have to cross under CR 666, requiring construction of a roadway bridge.

3.5.2.3.1D Comparison of Alternatives

The primary advantage of Alternative 2 is that less environmental impact will occur to wetlands within the proposed East Range Property Boundary. The primary disadvantages are i) there are limited locations at which to construct the rotary coal dumper; ii) the track elevation on the east end is 35 feet higher in elevation than the west end (making the profile grades difficult); and iii) the total coal train aesthetic impacts are spread over a larger area (the trains will be more visible from CR 666, noise impacts will be more discernable, and dusting from the rail cars would increase because the cars would be more exposed to the wind).

Similar to Alternative 1, the track is not located near any residential buildings, requires some wetland mitigation, and is impacted by its proximity to the nearby waste rock dump.

Table 3.5-4 provides a quantitative comparison between the two rail alignments.

Table 3.5-4
East Range Railroad Alternatives Analysis

	Alternative 1	Alternative 2
Total length of track (miles)	3.4	3.5
Length of track outside Buffer Land (miles)	1.25	2.1
Train speed (mph)	10	10
Maximum grade	0.40 %	0.40%
Maximum Curvature (loaded coal train)	2 degree 30 minutes	3 degrees
Off site right-of-way (acre)	15	26
Largest cut (ft)	50	50
Largest fill (ft)	20	20
Approximate cut Qty (cu.yd.)	2.3 million	2.1 million
Approximate fill Qty (cu.yd.)	60,000	65,000
No of residences within 1000 feet	0	0
Closest residence (ft)	3.750	3,750
Acceptable alignment?	Yes	Yes

3.5.2.4 Construction

Construction of the new railroad trackage will require rights of way to be obtained. The proposed right-of-way will be 100 feet wide with additional width needed in some of the cuts or fill sections. A typical track cross section based on the Railroad Design Guidelines summarized in Table 3.5-2 was developed and is presented in Figure 3.5-5.

The track work would begin immediately after construction approval has been received. The track and grading would take approximately 6 to 9 months to construct.

Railroads are constructed similar to roadways. The track will be constructed on a 100-foot wide right-of-way with a 32-foot wide prepared roadbed on which the track will be constructed. There may be areas where permanent or temporary easements will be needed to accommodate the larger fill or cut sections. Native soils are suitable for use in embankment construction on 1:3 side slopes. The side slopes will be 1:3 with a 5-foot wide flat bottom ditch for drainage. The prepared roadway will have the track offset to one side of centerline to allow for a 12-foot railroad inspection road along side. Finished embankments will be top-soiled and vegetation reestablished.

The coal unloading process requires the track elevation to be level. The grading and track work will be built using best practices and conform to the American Railway Engineering and Maintenance of Way Association ("AREMA") standards.

The track alignment and construction limits will be established by a field survey. The ROW will be cleared following accepted industry practices and sound construction guidelines. In areas where timbering is required, the trees would be cut in uniform length and stacked along the ROW for recycling. Debris created from preparation of the ROW would be disposed of using approved methods.

The low areas will be filled and hills will be removed to provide a smooth grade. Drainage structures and bridges will be built. These activities will be done with large earth moving equipment normally used for road building. The embankments will be compacted and 12 inches of finely graded compacted granular material (sub-ballast) will be placed on the top. Vegetation will be reestablished on the slopes and other impacted areas. Detailed discussion regarding wetland impacts and treatment are in Sections 7.7.11 and 8.7.4.11.

After the sub-ballast is placed, specialized construction equipment will be used to construct the track. The track will consist of railroad ballast (rock), steel rails, timber crossties and other miscellaneous materials. A stockpile area for the track material will be located on the plant site. The material will be distributed by truck to the final location and the rails will be carefully spiked to the proper gage on the crossties. Railroad ballast will be dumped using construction equipment mounted on the rails. A specialized piece of construction equipment, called a tamper, will be used to raise the track through the ballast, and the ballast will be compacted under the crossties. The track surface will be smoothed to a tolerance of 1/16 of an inch. The ballast will then be shaped to form a uniform ballast section.

3.6 WATER SUPPLY AND WATER/WASTEWATER MANAGEMENT INFRASTRUCTURE

3.6.1 Process Water Supply

3.6.1.1 West Range Process Water System

One of the reasons the West Range Site is an exceptional location for a power plant site is that abundant sources of water are located nearby. Several abandoned mining pits located in proximity to the boundary of the Buffer Land are either currently filled with water and overflowing, are being pumped to avoid flooding of important historical resources due to rising water levels, or are threatening to flood due to rising water levels. Specifically, these Pits include the LMP, the HAMP Complex, and the CMP. (These mine pits are shown on Figure 3.4-6. As noted in Table 3.6-1 below, the Arcturus, Gross-Marble, and Hill-Annex Mine Pits combine to form the HAMP Complex). The present circumstances allow Mesaba One and Two to become part of the solution to a difficult problem for the communities surrounding these resources and for the State of Minnesota, which is currently paying to pump water out the HAMP Complex to maintain acceptable levels. Tables 3.6-1 through 3.6-4 and the discussions that accompany them outline the analysis undertaken to assess the unique match between water resources and power station requirements.

The Applicant has identified the resources listed in Table 3.6-1 as the sources of process water for operation of the Phase I and II IGCC Power Station at the West Range Site. The chemistry of the waters listed in the table is presented in Table 3.4-20 in Section 3.4.2.2.3.

Table 3.6-1
Process Water Resources Identified for Use at the West Range Site

<table>
<tr><th>Potential Resource</th><th>Over-Flowing Or Rising?</th><th>Information Source</th><th>Phase</th><th>Alternative</th></tr>
<tr><td>CMP</td><td>Rising</td><td>MDNR</td><td>I/II</td><td rowspan="4">1</td></tr>
<tr><td>HAMP Complex*</td><td>Dewatered on ongoing basis to avoid flooding of Hill-Annex State Park</td><td>MDNR and Barr</td><td>I/II</td></tr>
<tr><td>LMP</td><td>Overflowing</td><td>SEH Field Data</td><td>I/II</td></tr>
<tr><td>Prairie River</td><td>NA</td><td>Minnesota Power</td><td>I/II</td></tr>
<tr><td>Greenway Mine Pit</td><td>Overflowing</td><td>SEH Field Data</td><td>II</td><td>Considered as Part of Alternative No. 1, but Rejected on Basis of Cost Effectiveness</td></tr>
<tr><td>Mississippi River</td><td>NA</td><td>MDNR</td><td>II</td><td>2</td></tr>
<tr><td>Groundwater</td><td>NA</td><td>None</td><td>I/II</td><td>3</td></tr>
</table>

*The HAMP Complex includes the Arcturus, Gross-Marble, and Hill-Annex Mine Pits.
NA = Not Applicable

The amount of water currently available in each of the source water mine pits is presented in Table 3.6-2.

Table 3.6-2
Abandoned Mine Pit Water Sources

Water Source	Water Surface Elevation (feet) (November 2005)	Surface Area (acres) (November 2005)	Estimated Volume (acre-feet) (November 2005)
CMP	1,309	1,400	150,000
HAMP Complex			
Hill-Annex Mine Pit	1,249	216	20,600
Arcturus Mine Pit	1,269	105	4,490
Gross/Marble Mine Pit	1,249	141	11,100
LMP	1,265	82	8,310

The sustainable[15] supply capability for each water source was estimated using information supplied by the MDNR, previous engineering studies, and information supplied by local government units. The actual sustainable rates that will be realized are dependent on factors including precipitation, evaporation, pit water levels and hydrogeological conditions. The estimated water source supply capabilities are presented in Table 3.6-3.

Table 3.6-3
Water Source Supply Capability

Water Source	Est. Range of Flow (gpm)	Assumed Sustainable Flow for Water Balance Modeling (gpm)
CMP	810-4,190	2,800
HAMP Complex	1,590-4,030[a]	2,000[b]
Lind Mine Pit	1,600-2,000	1,800[c]
Prairie River	0-2,470[d]	2,470[d]
Discharge from IGCC Power Station	350-3,500	Varies[e]

[a]Maximum flow occurs at minimum operating elevation.
[b]At an operating elevation of 1,230 ft msl.
[c]Estimates of flow are based on one summer flow measurement at the LMP outlet and one summer and one winter measurement taken at the West Hill Mine Pit outlet.
[d]Maximum available flow assumed to be 25% of the 7Q10 flow of the Prairie River.
[e]Water returned to the CMP is expected to be 300 gpm during Phase I operations and 2,650-3,500 gpm during Phase II operations.

Table 3.6-4 matches the water needs shown for the IGCC Power Station (this table contains information from Table 3.4-16 with two columns added) with the potential supplies shown in Table 3.6-3. The assessment regarding long term sustainable flows was based on: i) discussions with the MDNR regarding the availability of water in each of the above resources; ii) analyzing stage-storage data made available by the MDNR; iii) reviewing information the MDNR had published on each such resource; and iv) collecting primary data to confirm the available resource. The last column in Table 3.6-4 represents the Applicant's conclusion with regard to the capability of the resources listed to meet the operational requirements of Mesaba One and Mesaba One and Mesaba Two. The conclusion regarding water supplies is that sufficient water supplies are available to demonstrate the long term, sustainable provision of water for the Station's needs.

[15] The term sustainable is used in this context to imply that water levels within all pits be kept at levels that will be somewhat consistent with existing uses.

Table 3.6-4
Water Appropriation Requirements Matched with Water Supply Capabilities

Phase	Average Annual Appropriation (GPM)	Peak Appropriation (GPM)	Long Term Sustainable Flow (GPM)	Sufficient to Meet Annual Avg. Flow Requirement (Yes/No)
Mesaba One	4,000[a]-4,400[b]	6,500	> 9,100[c]	Yes
Mesaba One & Two	8,800[b]-10,300[d]	15,200	> 9,100[c] > 11,700[e]	Yes

[a]Based on 8 COC in the gasification island and the power block cooling towers

[b]Based on 5 COC in the gasification island and the power block cooling towers

[c]The flow presented is the sum of the values in the third column of Table 3.6-3 rounded to two significant figures; greater than symbol is applied because quantity does not account for 300 gpm recycled to CMP during Phase I operations (see Figure 3.4-12)

[d]Based on 3 COC in the gasification island and the power block cooling towers

[e] The flow presented is sum of the values in the third column of Table 3.6-3 and includes the minimum quantity of water expected to be returned to the CMP during the combined operation of Mesaba One and Mesaba Two rounded to two significant figures; greater than symbol is applied because quantity assumes minimum quantity recycled to CMP (see Figure 3.4-13)

For the combined needs of Mesaba One and Mesaba Two, existing data currently shows that greater flows than those presented in Table 3.6-4 for the CMP might possibly be available as inflows of water may increase (relative to the value presented in Table 3.6-4) with decreasing water levels in the CMP. To be conservative, the Applicant has not assumed the availability of such potential excess flows.

Information available for the HAMP Complex also suggests increased water flows into the HAMP Complex with decreasing water elevations. For example, records show evidence of flows between 3,900 and 4,000 gpm during the initial years following cessation of mining. However, this increased flow is also not used in the sustainable flow values presented in Table 3.6-4. Additional flow is available from non-contact cooling water discharges from the IGCC Power Station directly into the CMP. The basis for direct discharges into the CMP is discussed in greater detail in Section 7.6.4.4 and in the NPDES Permit Application that is provided at Appendix 6. Such discharges would be conducted in accordance with all rules and regulations and could decrease reliance on one or more of the water resources listed. However, because of the uncertainty of sufficient flows for Mesaba One and Two from such sources, the Applicant has chosen to also propose water appropriation from the Prairie River and the LMP to ensure adequate water supplies for both phases.

Each of the water resources identified above is at a lower surface elevation than that of the IGCC Power Station. Therefore, conveyance of the water to the Station requires that it be pumped. Figure 3.4-6 provides the location for the process water pump stations and pipelines.

Section 7.6-1 supplies additional information regarding each of the water resources discussed above.

3.6.1.2 East Range Process Water Supply

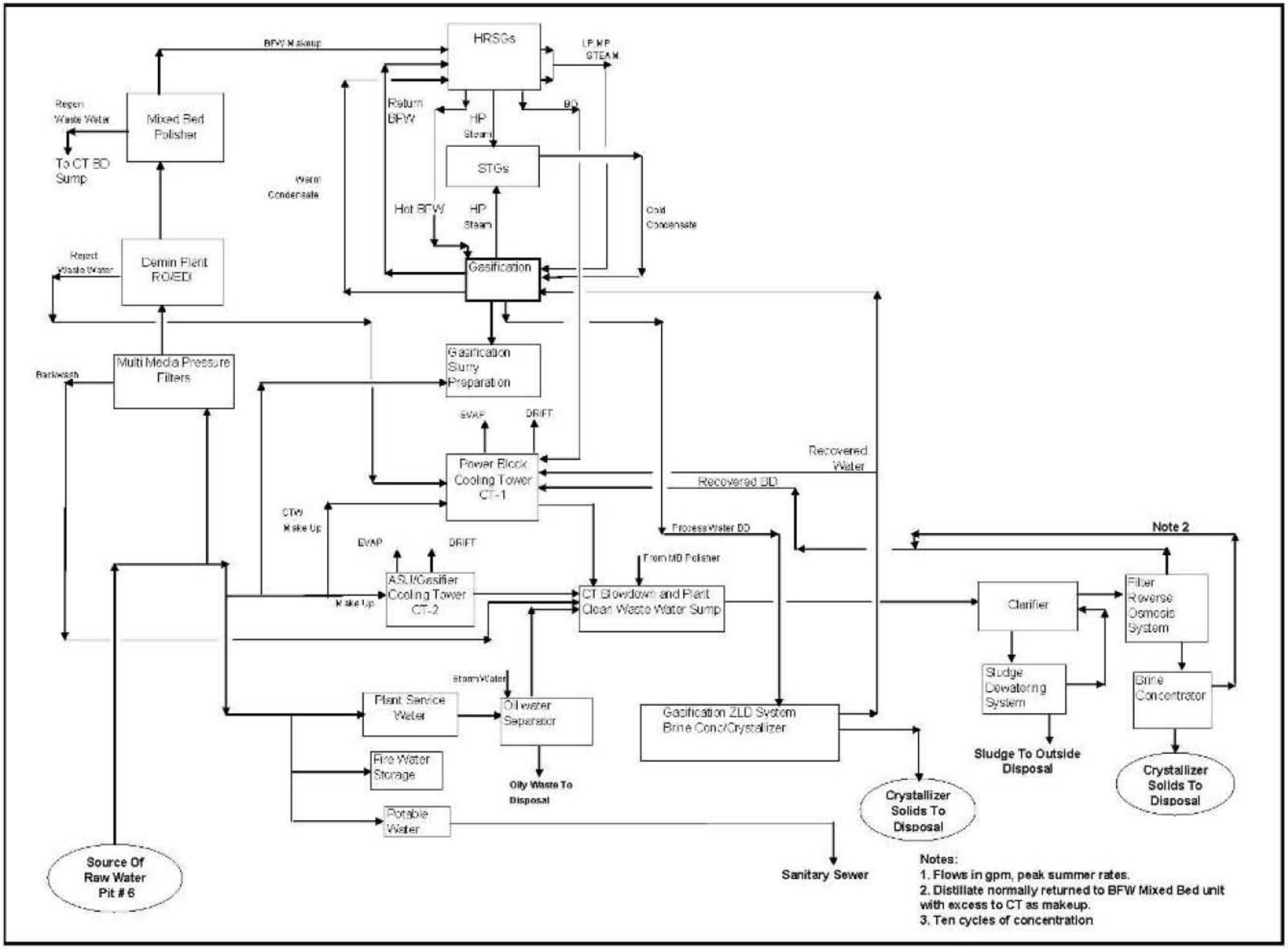
3.6.1.2.1 Water Supply Requirements

As shown in Section 3.6.2.1 and in Table 3.6-6, the water supply required to serve the East Range IGCC Power Station is reduced in comparison to that required for the IGCC Power Station located on the West Range Site. Figure 3.6-1 shows that cooling tower blowdown that would otherwise be discharged to receiving water (for example, CMP and Holman Lake in the case of the West Range IGCC Power Station) is processed through a reverse osmosis ("RO") system to recover water that can be recycled within the Station. The brine wastewater from the RO is processed in a mechanical vapor recompression evaporator/crystallizer that serves as the principal component of the ZLD system (see Section 3.1.6.3 for a description of the ZLD system applied to contact water cooling). Water recovered from the ZLD system is recycled for make up water where needed.

As shown in Table 3.6-6, water appropriations can be reduced by up to 700 gpm per phase through use of such recycling efforts. The auxiliary power required to operate the ZLD system is estimated to be about 2 MW per phase. In addition, the TDS present in the East Range mine pit waters produces significant quantities of additional solids that must be disposed of in an industrial solid waste landfill (see Section 3.4.4.1.3).

Although the ZLD system's power consumption and solids production are negatives in an economic context, the ZLD system allows the IGCC Power Station to potentially play a synergistic role with industrial mining operations seeking to locate on the East Range industrial site. The potential for such industrial synergies is discussed in Section 3.4.3.3. In the following section, the opportunities for reusing water (turning what might be considered a waste stream from the mining entities into a source of water for the IGCC Power Station) are identified.

Figure 3.6-1 East Range ZLD System to Eliminate Cooling Tower Blowdown



3.6.1.2.2 Process Water Sources

Sources of water to meet the needs of Mesaba One and Two on the East Range Site are identified in Table 3.6-5 below. The sustainable supply capability for each water source was estimated using information supplied by the Minnesota Department of Natural Resources, previous engineering studies, and information supplied by local government units. The actual sustainable rates that will be realized are dependent on several factor, including precipitation, evaporation, pit water level and hydrogeological conditions. These sources are shown relative to the location of the facility in Figure 3.6-2. Water levels in several of the pits are rising, but pose no current threat to public health and/or welfare unlike levels in the HAMP Complex and CMP. And, unlike the CMP and HAMP Complex, there is no immediate need to control water levels in any of the pits on the East Range Site. Therefore, water supplies from any of the individual East Range pits can be over-pumped as necessary to meet demands of Mesaba One and Mesaba Two. As noted for the West Range Site, the water supply plan for the East Range Site is subject to environmental review and permitting process approvals.

Table 3.6-5
Water Supply Alternatives for the East Range IGCC Power Station

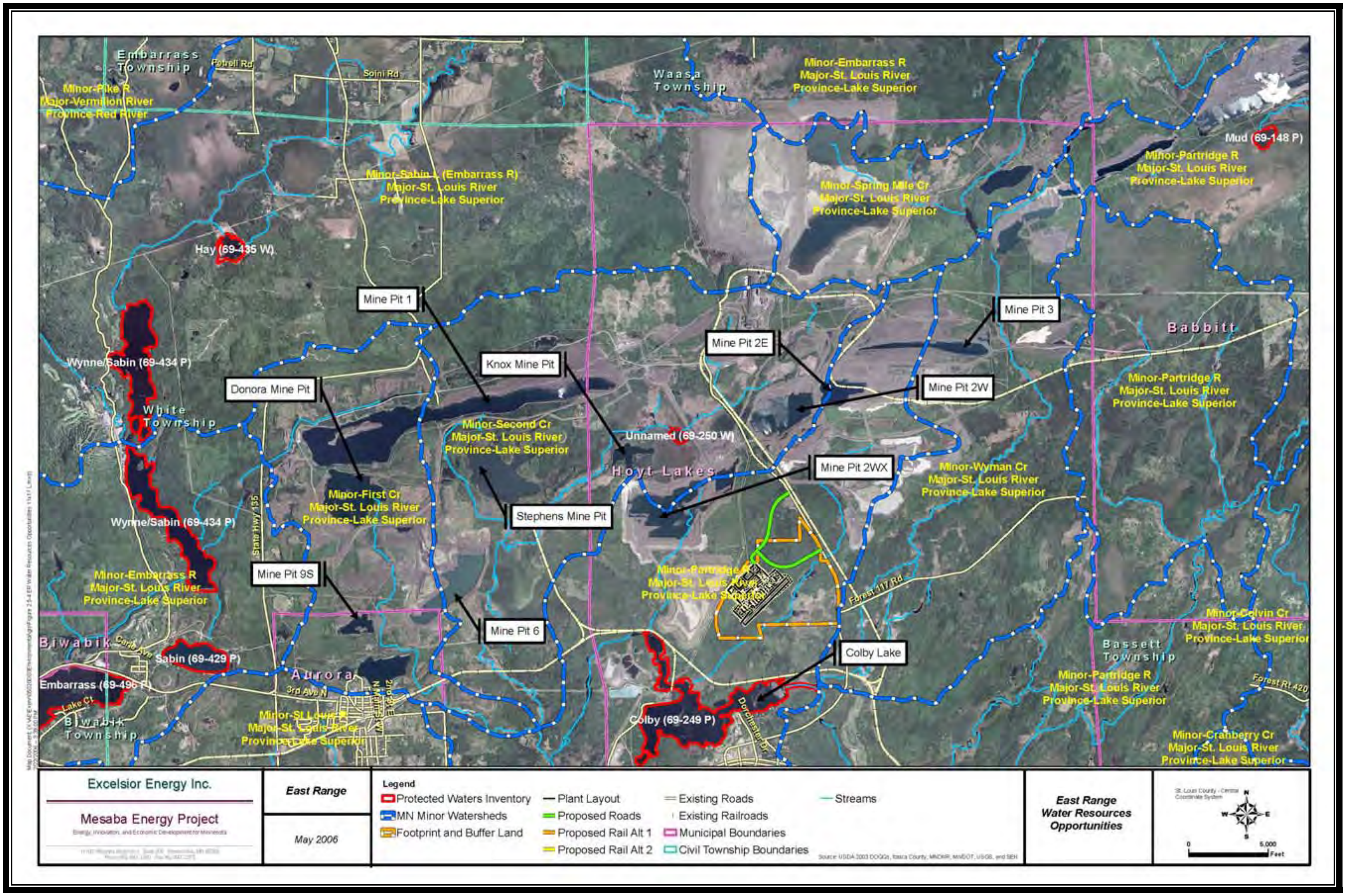
Abandoned Mine Pit	Estimated Range of Flow (gpm)	Information Source (See Table Footnotes)	Average Annual Flow (gpm)
Mine Pit 6		1	1,800
Mine Pit 2 WX(West Extension)		1	700
Mine Pit 2 West		1	900
Mine Pit 2 East		1	100
Mine Pit 3	150-450	2	300
Donora Mine Pit	130-380	2	260
Stephens Mine Pit	190-590	2	390
Knox Mine Pit	20-70	2	45
Mine Pit 9S	90-270	2	180
Mine Pit 1 Effluent	0-1000	3	1,000
PolyMet Mining Dewatering Operations	2,000-8,000	4	4000
Colby Lake		5	2,900
		Total Resource (gpm)	12,600

1. East Range Hydrology Report, MDNR, Division of Lands and Minerals, Division of Waters, March 2004.
2. Range of flow based on the surface drainage area to the pit and average yearly rates of runoff. This should be considered a gross approximation as the actual flow rates are likely much more dependent on groundwater components. The groundwater inflow/outflow component in this area can be highly variable as a result of fractures in the bedrock and/or highly pervious tailings dikes. Due to the complexity associated with the groundwater component, groundwater inflow/outflow has not been evaluated.

3. MPCA NPDES Permit Issued to Mesabi Nugget. Mine Pit 1 effluent represents the wastewater discharged from Mesabi Nugget's permitted operation of Mine Pit 1 in accordance with terms of a NPDES Permit.
4. North Met Mine Environmental Assessment Worksheet.
5. Cliffs-Erie Omnibus Agreement, Exhibit I-B-1.

The total water available in these pits is considerable, having a combined surface area on the order of 1,300 acres. The Applicant continues to refine its Water Resource Management Plan for the East Range Site. However, given the number of voluminous sources of water on the site, the flexibility of operating them over a wide range of water levels, and the capability of supplementing such sources with water from Colby Lake during periods of high flow, the amount of water to sustain Mesaba One and Two over the long term is reasonably assured.

Figure 3.6-2 East Range Site Water Resources in Relationship to IGCC Power Station



3.6.2 Process Water Infrastructure

3.6.2.1 Site Independent Infrastructure

Process water is required at the IGCC Power Station for the following purposes: i) as the prime mover in the steam cycle, ii) to condense steam used in the power cycle (the water from which the steam in the power cycle will originate is of very high quality and, for economic reasons, could not simply be vented to the atmosphere as low grade steam); iii) for slurrying coal fed to the gasifier; and iv) for various other contact/non-contact cooling purposes. Table 3.6-6 is provided to show the annual average and peak rates at which water would be appropriated for all such purposes.

Table 3.6-6
Water Appropriation Requirements

Phase	West Range IGCC Power Station		East Range IGCC Power Station	
	Average Annual Appropriation (GPM)	Peak Appropriation (GPM)	Average Annual Appropriation (GPM)	Peak Appropriation (GPM)
Mesaba One	4,000[a]-4,400[b]	6,500	3,700[a]	5,000
Mesaba One & Two	8,800[b]-10,300[c]	15,200	7,400[a]	10,000

[a]Based on 8 COC in the gasification island and the power block cooling towers
[b]Based on 5 COC in the gasification island and the power block cooling towers
[c]Based on 3 COC in the gasification island and the power block cooling towers

The largest share of the water appropriated is consumed by evaporative cooling. Figures 3.4-9 and 3.4-10 indicate that the annual average rate of evaporative loss would be on the order of 3,320 gpm for Mesaba One, with evaporative losses from Mesaba Two expected to be identical. Peak evaporative losses for each phase of the IGCC Power Station are identified in the NPDES permit application as approaching 3,500 gpm. Peak utilization rates will occur on hot summer days.

The maximum appropriation of water from the resources at either site will be dependent upon many factors, including: cycles of concentration in the cooling towers; fuel consumed; ambient conditions; the extent to which cooling tower blowdown is treated to remove total dissolved solids; the chemistry of the receiving waters; and the water quality criteria standards applied to those waters. The cycles of concentration in the cooling towers will be dependent upon source water chemistry, including the concentrations of mercury, total dissolved solids and hardness. In general, if the source water is relatively low in total dissolved solids, the cycles of concentration in the IGCC Power Station's cooling towers can be increased, resulting in lower make-up rates.

The West and East Range IGCC Power Stations do not differ greatly in their need for water, but do differ greatly in how wastewaters from the Power Station must be managed. In the case of the East Range IGCC Power Station, all wastewaters (other than domestic wastewaters) must be processed through a ZLD system such that there will be no process-related wastewaters, including non-contact cooling tower blowdown, discharged from the Power Station. As noted, the reason for the difference in approach between the two sites is a function of the East Range

Site's location in the Lake Superior Basin watershed (see Section 3.4.2 to obtain citations to the rules governing discharges to this watershed). The water quality criteria standards for mercury applied to surface waters in this watershed are 1.3 nanograms per liter. Dischargers to surface waters in that watershed must meet this stringent standard at the end of the discharge pipe (that is, there is no allowance for a mixing zone within which the concentration of mercury is allowed to equilibrate). The background concentration of mercury in the East Range source waters is on the order of 0.5-0.9 nanograms per liter, resulting in cooling tower blowdown concentrations of mercury in the range of 1.5-9.0 nanograms per liter (assuming that three to ten COC were used in the cooling tower).

The site-specific issues identified in the preceding paragraphs (as well as the prohibition on new or expanded discharges of certain chemicals to waters that are impaired because of such chemicals) is discussed in more detail in Section 7.6.4.4. Essentially, the combination of these two considerations lead to the conclusion that at the East Range Site, discharges of cooling tower blowdown must be entirely avoided in order to obtain required preconstruction permits.

3.6.2.1.1 Water Intakes and Pumping Systems

The types of water intake structures and pumping systems will be similar for the West and East Range Sites. Two types of intake structures will be employed for withdrawal from water resources: one designed for permanent withdrawals and one for seasonal withdrawals. Both systems must be designed to be compliant with § 316(b) of the Clean Water Act ("CWA"). Rules promulgated in support of § 316(b) are published at 40 C.F.R. Part 125 ("Criteria And Standards For The National Pollutant Discharge Elimination System"), Subpart I ("Requirements Applicable to Cooling Water Intake Structures for New Facilities Under Section 316(b) of the Act") and contain design criteria pertinent to the Mesaba One and Mesaba Two process water supply system.

As the front end engineering and design of the IGCC Power Station proceeds, the design concepts presented here will be tailored to each specific circumstance and optimized to reduce power consumption demands. A conceptual design for the two types of intake systems (a caisson intake system for permanent applications and a floating intake system for seasonal use), are described below and illustrated in Figures 3.6-3 and 3.6-4, respectively.

3.6.2.1.1A Caisson Intake

This concept includes construction of a 13–20 foot diameter vertical shaft that will act as a wet well. The caisson will be formed with concrete in the unconsolidated overburden but may utilize the bedrock as a wall in the deeper parts of the structure depending on competence and fractures. The actual diameter of the vertical shaft will be based on equipment requirements such as the number of pumps and the dimensions of the pumping equipment, as well as on constructability issues related to connecting the shaft to the pit. The caisson will be constructed to an elevation necessary to obtain submerged pumping conditions under the lowest anticipated pit water levels, including an emergency buffer. Connecting the shaft to the pit can be accomplished by several methods. One such method includes constructing a large horizontal tunnel, approximately 10 feet diameter, from the caisson to the pit for water collection.

Water will enter the central caisson through the horizontal tunnel and rise to the normal water elevation. The horizontal tunnel would be constructed using hard rock tunneling techniques. The tunneling would be stopped short of the pit to allow the equipment to be removed prior to flooding of the caisson by pit water. The final opening from the horizontal intake tunnel to the pit would be made blasting or drilling on the pit side from a barge on the pit water surface. The horizontal tunnel will be sized to limit intake velocities to 0.5 feet per second. With this method, CWA screening requirements of Section 316(b) of the CWA will be met in the caisson using either tee screens or conventional well screens. Pumps in the caisson will be conventional turbine pumps commonly used in wet well applications.

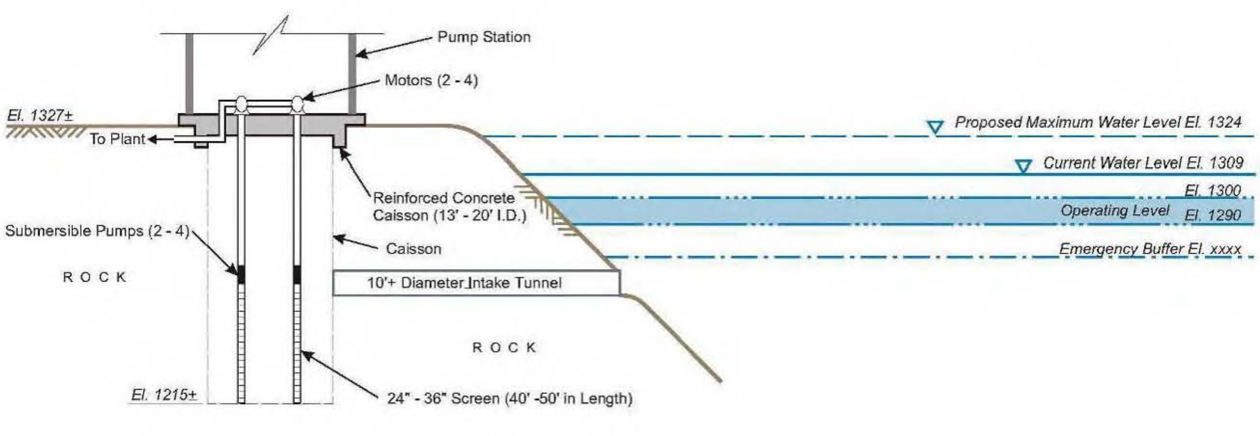
A second method to withdraw water from the pit is to use diagonal drilling methods to install several smaller diameter holes (roughly 36" in diameter) into the pit. Using this method, piping could be fitted with screens that will extend in the pit to meet CWA Section 316(b) intake velocity requirements. Submersible pumps would be used in this configuration.

Using either method, a system will be installed that will allow access to the deeper, cooler water if determined to be necessary or cost effective. A new supply pipe will be constructed from the caisson to deliver water to the IGCC Power Station for cooling and other plant needs.

A section of this concept is shown in Figure 3.6-3. This design provides:

- A system that meets CWA Section 316(b) requirements that reflect the best technology available (BTA) to protect aquatic organisms from impingement or entrainment.
- Reliable construction that will minimize potential maintenance and supply issues.
- An inlet tunnel that is designed to limit intake velocities to 0.5 feet per second to meet CWA Section 316(b) requirements and allow fish to freely swim in and out of tunnel.
- Installation of well screens or tee screens to meet CWA Section 316(b) requirements, thereby eliminating requirements for a flat panel wedgewire intake screen at the entrance to the horizontal tunnel.
- Well screens, if used in the caisson, installed so that they could be removed for maintenance.
- A caisson depth designed to allow access to the deeper water if desired and to ensure thermal stratification is not negatively disrupted. The structure could also be modified to include some form of deeper suction piping to feed the main intake with deeper colder water.

Figure 3.6-3. Conceptual Illustration of Caisson-Type Intake Structure



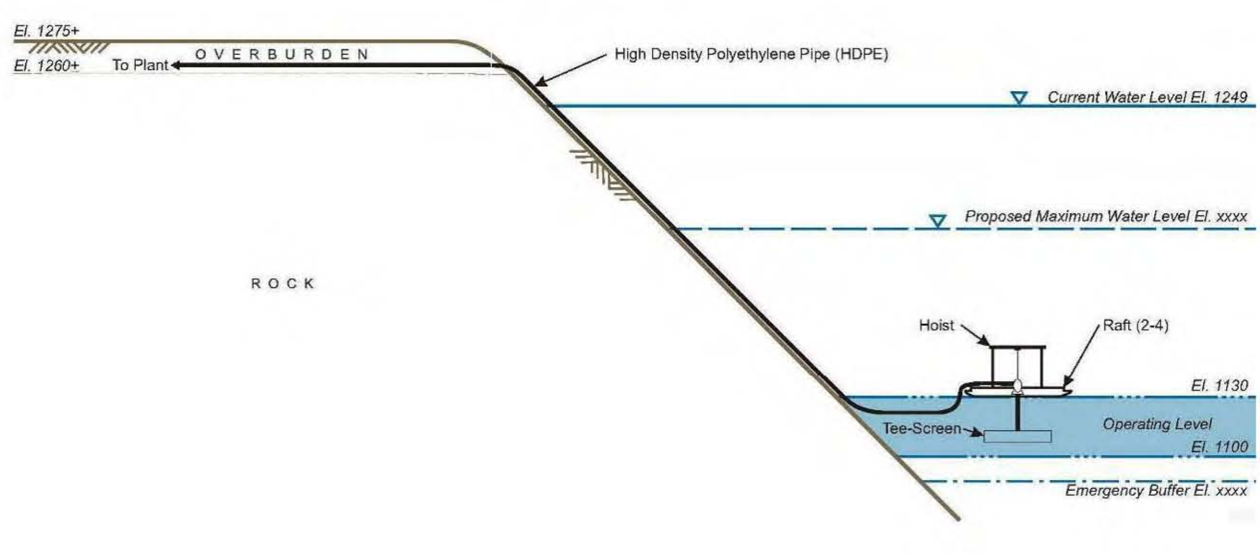
3.6.2.1.1B Floating Intake

Floating intake structures conducive to fluctuating water levels are available and commonly used by mines for pumping systems. This system includes placing pumps and intake structures on a floating platform in the mine pit. A pipe with wedgewire screen is extended to withdraw water from the desired depth. A sufficient length of screen will be provided to ensure intake velocities are maintained below 0.5 feet per second and to ensure thermal stratification is not negatively disrupted. Supply pipe will be designed to convey water from the floating platform to the facility.

A section of this concept is shown in Figure 3.6-4. This design will provide:

- A system that meets CWA Section 316(b) requirements by employing the best technology available (BTA) to protect aquatic organisms from impingement or entrainment.
- Consistent suction characteristics for the pumps (fluctuating water surfaces could otherwise be problematic).
- Readily accessible main components (except for the deeper intake components).
- Economical construction costs.
- Potential for use of off-the-shelf systems.
- An easily accessible submerged pump intake.
- The option for using less expensive horizontally mounted motors.
- A floating dock or other pier structure to allow for maintenance and access to the intake structure. Bubblers or agitators could be utilized to prevent freeze-up if winter operation is necessary.

Figure 3.6-4. Conceptual Illustration of Floating-Type Intake Structure



3.6.2.2 West Range Process Water Infrastructure

The proposed process water supply system for Mesaba One and Two will consist of three mine pits, three pumping stations, and an engineered orifice to draw water from the Prairie River. In the case of Mesaba One, water in the CMP will be pumped to the IGCC Power Station and water from the HAMP Complex will be pumped to the CMP to maintain appropriate water levels (the intent in the early years of the IGCC Power Station's operation will be to lower water levels in the CMP to eliminate the flooding threat and to allow for construction and utilization of existing railroad facilities). Mesaba One and Two will require an additional pump station on the LMP and installation of an engineered orifice that allows water from the Prairie River to flow by gravity to the LMP. A pumping station in the LMP will then pump water to the CMP. The pumping capacity for each pump station is summarized in Table 3.6-7

Table 3.6-7
West Range Pumping Station Capacities

Pump Station Location	Peak Flow (gpm)
CMP (see Figure 3.6-5)	15,200
HAMP Complex (see Figure 3.6-6)	7,000
LMP (see Figure 3.6-7)	7,000

3.6.2.2.1 CMP Pumping Station

A series of pumps will provide a pumping capacity between 3,500 gpm and 7,000 gpm for Mesaba One and between 8,800 gpm and 15,200 gpm for Mesaba One and Two. This capacity will be provided in a permanent pumping station located at the southeast corner of the CMP (see Figure 3.6-3 for a conceptual illustration of the caisson-type pump station). A standby pump will be incorporated for use during a failure or maintenance of one of the primary pumps. The pump station intake will meet CWA Section 316(b) requirements for cooling water intake structures (addressed in the NPDES permit). The pipeline that extends from the CMP to the West Range Site will be approximately 36 inches in diameter. The length of the pipeline that extends from the CMP to the boundary of the Buffer Land is approximately 11,000 feet.

3.6.2.2.2 HAMP Complex and LMP Pumping Stations

A floating pump station will be installed at the Gross-Marble Mine Pit ("GMMP") end of the HAMP (see Figure 3.6-4 for a conceptual illustration of the floating pump station). The pump station will have a capacity of 7,000 gpm and will be direct water to the CMP. The pipeline that extends from the GMMP to the CMP will be approximately 24 inches in diameter and approximately 25,400 feet in length.

A pump station designed in the same manner as the HAMP Complex pumping station with a capacity of 7,000 gpm will be installed in the northeast corner of the LMP, and will be direct water to the CMP. The pipeline that extends from the LMP to the CMP will be approximately 24 inches in diameter with an approximate length of 11,300 feet.

Pumping capacity at the HAMP Complex and the LMP must allow for the seasonal capture of the 12-month average annual water supply.

3.6.2.2.3 Prairie River Intake

An engineered intake structure capable of accepting a maximum rate of 2,470 gpm from the Prairie River will be installed in the river and directed into the LMP for storage. The engineered intake structure will be approximately 18 inches in diameter and approximately 200 feet in length.

3.6.2.2.4 Pipeline Infrastructure

Routing for the pipelines will be primarily on public property adjacent to existing transportation corridors. Figures 3.4-5, 3.4-6, 3.4-12 and 3.4-13 show an overview of the water supply plan. Figure 3.4-14 provides an overview of the water intakes and discharge points. Finally, Figures 3.6-5, 3.6-6, 3.6-7 and 3.6-8 provide a detailed view of the developments at each intake and discharge location. Mapbooks showing the entire length of each segment of pipeline are attached as Appendix B of the Water Appropriation Permit Application for the West Range IGCC Power Station attached as Appendix 9 herein.

Figure 3.6-5 Canisteo Pump Station and Gross-Marble Pump Station Discharge Point

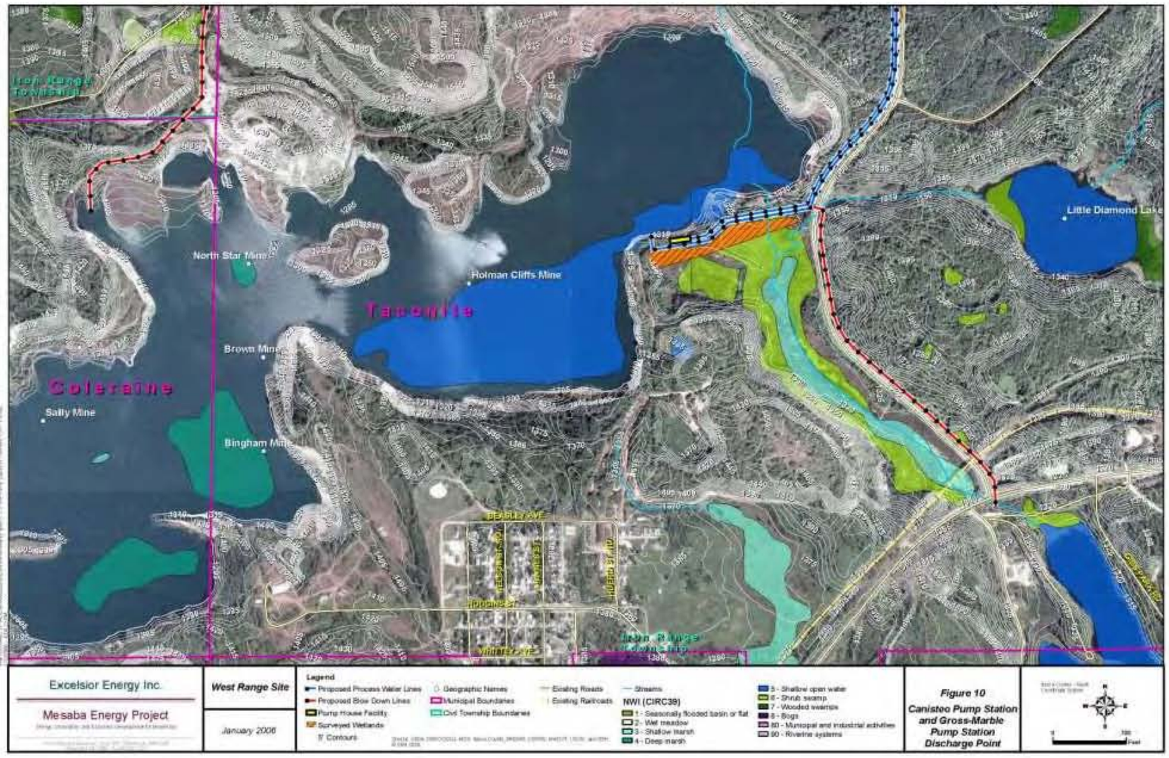


Figure 3.6-6 Gross-Marble Pump Station

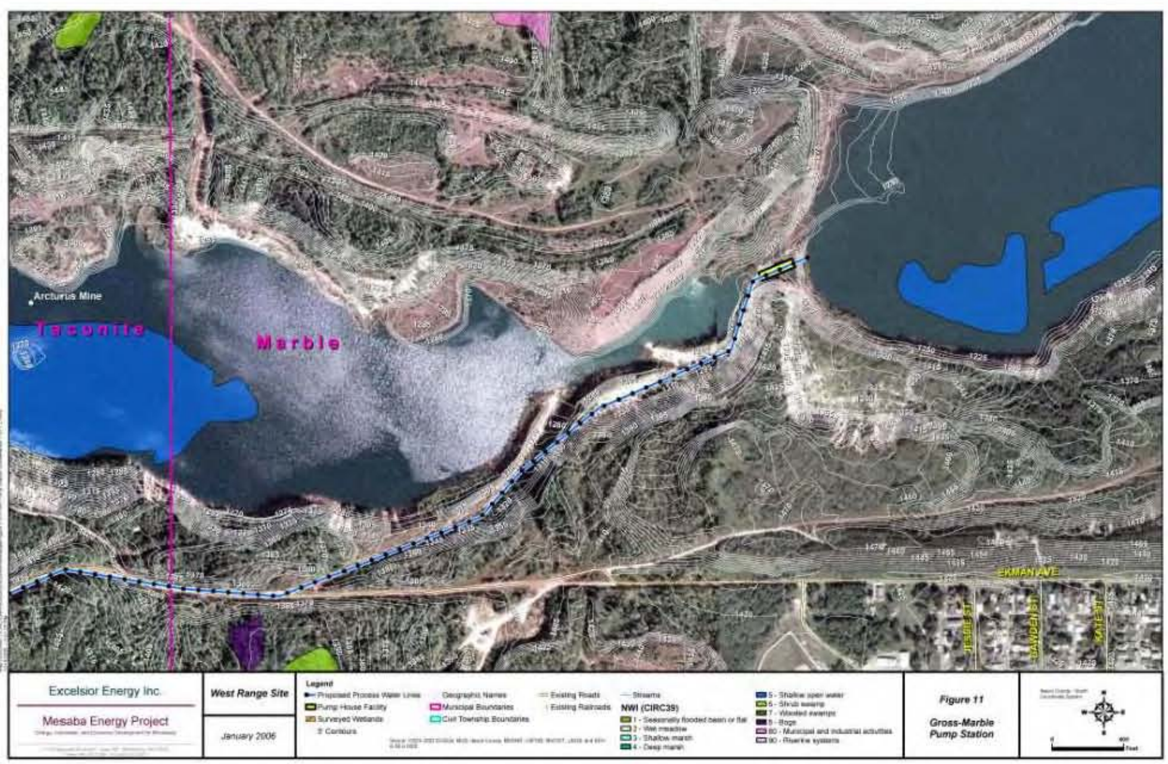
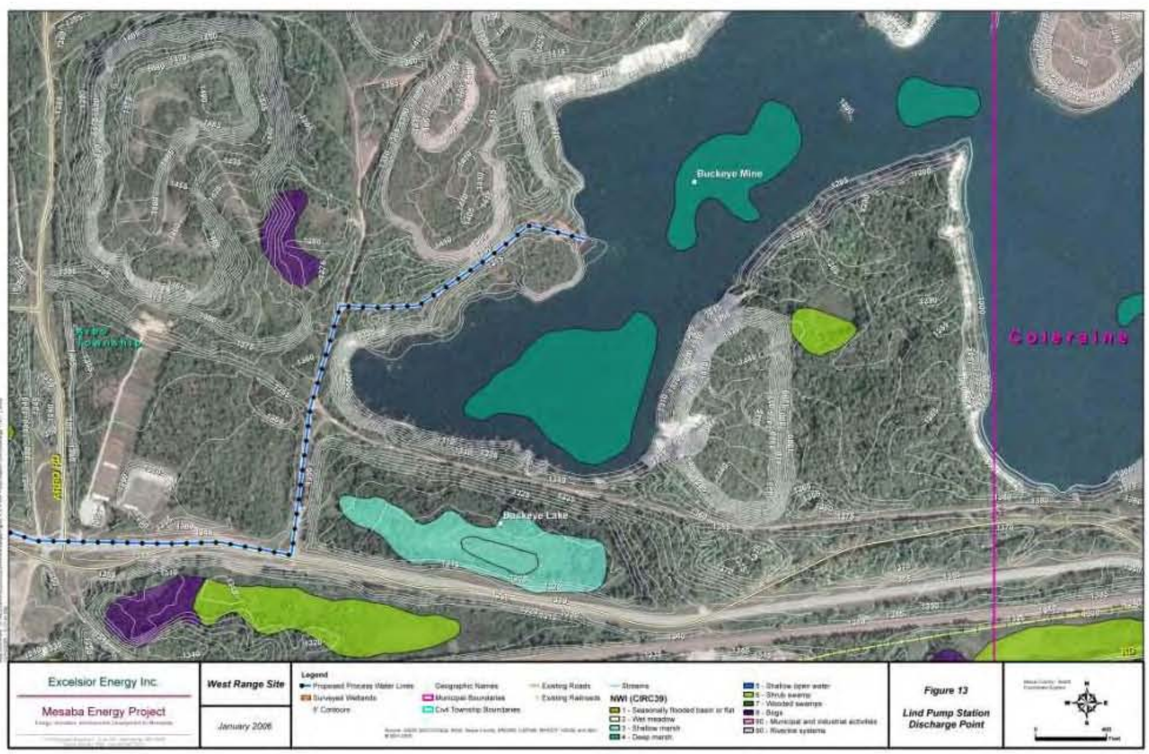


Figure 3.6-7 Lind Pump Station and Prairie River Intake Structure

Figure 3.6-8 Lind Pump Station Discharge Point



3.6.2.2.5 West Range Site Process Water Discharge Outfalls

The outfalls (water discharge points) associated with the discharge of cooling tower blowdown from the West Range IGCC Power Station are shown in Figure 3.4-14.

The CMP outfall (Outfall 001) will consist of a pipe or bored tunnel outlet about 75 feet below the current water level. The outlet may be installed by angled drilling. The other mine pit outfalls would be constructed similarly to the CMP outfall. The Holman Lake outfall (Outfall 002) consists of a conventional outlet entering the lake just below the surface of the water. The outlet will be installed by extending a peninsula of fill into the lake and excavating down to pipe invert level to install the pipe (the peninsula will allow work to be in near dry conditions). Thereafter, the fill will be removed and the lakeshore and lake bottom restored. Riprap will be installed around the flared end section to prevent scour.

3.6.2.3 East Range Process Water Infrastructure

3.6.2.3.1 2WX As Storage Reservoir

At the East Range Site, Mine Pit 2WX would be the reservoir from which the IGCC Power Station would appropriate water to meet its needs. This is similar to the function the CMP serves in the West Range Water Resource Management Plan. A permanent pumping station would be placed within Mine Pit 2WX and would receive input from one or more floating pumping stations strategically placed in the remaining mine pits identified in Table 3.6-5. In several instances, mine pit water may be relayed from one mine pit to another on route to the 2WX pit (for example, water from the Denora Mine Pit would be pumped to Mine Pit 6 and then to Mine Pit 2WX). The pipelines interconnecting the pits with one another and 2WX will be transportable to allow for contingency movements. The connection between Mine Pit 2WX and the IGCC Power Station will be a buried pipeline.

In the event of high inflow rates into Colby Lake during spring run off, or during high precipitation events, water will be pumped from Colby Lake into Mine Pit 2WX. The existing pumping station now serving the CE site from Colby Lake appears to be usable, but may require refurbishment.

3.6.2.3.2 Process Water Supply Pipelines

The Process Water Supply Pipelines required to connect East Range Water Resources to Mine Pit 2WX are identified in Table 3.6-8 below. The pipelines are shown in Figure 2.1-4.

Table 3.6-8
Process Water Supply Pipeline Data and Easement Owners

Segment ID No.	Process Water Supply Pipeline Segment No.		Appropriate Length		Owners					
	From	To	Feet	Miles	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
1	2WX	IGCC	4500	0.85	CE	Divided Interest	State of MN	St. Louis Co.		
2	2W	2WX	2670	0.5	CE	State of Mn	Divided Interest			
3	2E	2W	725	0.14	State of Mn	Great Northern				
4	3	2E	2925	0.55	CE	State of Mn				
5	Knox	2WX	865	0.16	RGGS	Divided Interest	State of MN			
6	6-S	2WX	11340	2.15	CE Stephens	Du Nord Land Co.	State of MN	RGGS	King	U of Mn
7	9S	6	2662	0.5	Du Nord Land Co.	RGGS	CE Stephens			
8	9N	6	5027	0.95	CE					
9	Colby Lake	2WX	8440	1.6	CE					

3.6.2.3.3 Pumping Station Capability

Preliminary estimates of required pumping station capabilities are presented in Table 3.6-9. Pump station peak flow capability will provide redundancy to supply daily peak and average needs in the event of a failure of a major pump station.

Table 3.6-9
Pumping Station Capability (Phases I and II)

Pump Station Location	Ave Yearly Flow (gpm)	Peak Flow (gpm)
2WX	7400	10,000
2E	112	1,000-2,000
2W	898	2,000-4,000
6	1795	4,000-8,000
3	300	1,000-2,000
9/Denora	260	1,000-2,000
9S	180	1,000-2,000
Stephens	390	1,000-2,000
Knox	45	1,000-2,000

The actual estimated pumping rates for the 2WX Mine Pit pump station are summarized in Table 3.6-10.

Table 3.6-10
2WX Mine Pit Pump Station – Expected Operation

	Phase I	Phase I and II
Yearly Average Flow	3700 gpm	7,400 gpm
Peak Operating Day (80 °F)	5,000 gpm	10,000 gpm

Mine pits will receive excess water in wet years and provide additional supply to cover shortfalls in dry years. The combined Phase I and Phase II Developments will require approximately 12,000 acre-ft (3,889 million gallons per year) of water each year.

Floating pump stations will be selectively installed on Pits 2E, 2W, 6, 3, 5N, 5S, 9, 9S, Stephens, and Knox. Pumping into Mine Pit 2WX will normally occur on a seasonal basis (no winter pumping). The number of pumps required will be determined pending further development of the East Range Water Management Plan.

3.6.2.3.4 Operating Plan

The Applicant will operate the water resources as an integrated system. The system must provide the following:

- Adequate redundancy to supply daily peak and average needs for Mesaba One and Two
- Storage of water in years of excess rainfall
- Delivery from storage in years of lower rainfall
- Emergency discharge of water from mine pits in cases of extreme rainfall

The following narrative describes how each resource is envisioned to be used.

3.6.2.3.5 Pit Operation Description

3.6.2.3.5A Mine Pit 2WX

The Mine Pit 2WX will be the foundation of the water supply system and will provide the following functions:

- Hosting the main make up water pump house
- Providing the primary supply of water Mesaba One and Mesaba Two,
- Accepting the selected inputs from Pits 2E, 2W, 6, 3, 5N, 5S, 9, 9S, Stephens, Knox, and dewatering flow from nearby mining operations as they are available.
- Providing water storage within a sufficiently wide operating range of pit elevations to accommodate wet and dry years.

3.6.2.3.5B Pits 2E, 2W, 6, 3, 5N, 5S, 9, 9S, Stephens, and Knox

Water will be seasonally pumped from these pits to maintain the level in Mine Pit 2WX.

3.6.2.3.6 Implementation Plan

The make up water pump house located on the Mine Pit 2WXwill be constructed during Phase I. The floating pumping stations and the associated piping for Mine Pits 2E, 2W, 6, 3, 5N, 5S, 9, 9S, Stephens, and Knox will also be installed during Phase I. Each year or January 1, the Applicant would provide notice of the pumping plan for the five-year period, beginning two yeas therefrom.

3.6.2.3.7 Pit Storage

The Mine Pits identified in the annual implementation will normally be pumped into Mine Pit 2WX during times of the year when average daily temperatures are above freezing. This will lead to an estimated seasonal level fluctuation of 15-20 feet because water will be drawn out of 2WX in the winter and not normally be replaced until the following summer season. It is anticipated that the level of 2WX will operate between the elevations of 1,435-1,455 feet msl. This is slightly higher than the current pit elevation of 1405 feet msl. The levels of Mine Pits 2E, 2W, 6, 3, 5N, 5S, 9, 9S, Stephens, and Knox will fluctuate as seasonal pumping occurs to control the level in Mine Pit 2WX within the 1,435-1,455 feet msl range.

3.6.3 Potable Water System

3.6.3.1 West Range Potable Water System

The closest potable water source to the West Range IGCC Power Station Footprint is the City of Taconite, located about 2.5 miles to the south. Taconite is permitted to use 20 million gallons a year based on its current ground water permit and is currently using 8 million gallons a year. Conservatively assuming that, on average, 1,000 construction workers will be working on-site every day during the 5-day work week, year round and using 30 gallons of potable water per person, the need would total about 11.8 million gallons per year. This is an overly conservative assumption and shows the City has excess well capacity and can provide the required potable water during and after construction of Mesaba One and Mesaba Two without the need to modify its existing groundwater permit.

To provide water to Mesaba One and Two, an 8” diameter pipeline will be constructed from the existing City system to the Station Footprint as shown in Figure 2.1-3. The referenced pipeline routing was chosen as the preferred route because it is the most direct route from the City to the Station Footprint and installation of the pipe at that location would be more economical because it would be bundled along with pipelines serving other processes. The alternate route considered would extend the pipe east from the City to U.S. Highway 169, run parallel along the west side of 169 to CR 7, parallel the west side of CR 7, and cross under the highway to the Station Footprint. This route is longer, would require more piping, and impacts a number of wet areas that would increase the cost of installation.

A booster station will be needed near the connection point to the City water distribution system in order to provide the required water pressure to the IGCC Power Station. The booster station would pump water from the Taconite system at a variable rate of 20 to 100 gpm. The wide pumping range is required due to the fluctuations in water use that would occur throughout the day at the Power Station.

Due to the possible expansion of the water system to the north, the City of Taconite is considering adding a residential/industrial sub-division on the south side of CR 7, south of the Buffer Land. The City has estimated the potable water requirement for the sub-division to be about 10,000 gpd, with an annual use of 4 million gallons. Presuming that peak construction activities associated with the Phase I and II Development do not significantly overlap with the needs of the new subdivision, the City has the well capacity to supply water to both the proposed sub-division and Mesaba One and Mesaba Two under its current ground water permit. Residential water use fluctuates widely over the course of the day and a 50,000 gallon elevated storage tank would likely be required to provide adequate flow for high use times and to provide storage for fire flow requirements. If the City decides to install the tower, the size of the booster station pumps will need to be increased to accommodate the increased head of pressure. The pumps in the booster station would increase in size to pump water at a constant rate of 200gpm. The booster station will pump water into the tower and the tower will provide water to the sub-division and the IGCC Power Station. Water from the proposed tower could also flow back to the City when the pumps were not running, providing additional water capacity to the City’s existing system. Due to the higher elevation of the proposed tower, water pressure would need to be reduced prior to entering the existing system.

The City of Taconite would own and maintain the booster station, pipeline, and tower and the Applicant would enter into an agreement with the City to purchase water. The design of the pipeline, booster station, and tower must meet the requirements of, and be approved by, the Minnesota Department of Health.

Construction of the potable water pipeline and booster station would require a full construction season. To ensure potable water is available at the IGCC Power Station during peak construction activities, construction of the pipeline and booster station must be initiated as soon as the preconstruction permits for the IGCC Power Station are received and the Notice to Proceed is issued. Until such time as potable water can be obtained from the City of Taconite, potable water requirements could be supplied by tanker truck or other means.

3.6.3.2 East Range Potable Water System

Potable water for the East Range IGCC Power Station will be provided by a connection to the City of Hoyt Lakes' water system. The IGCC Power Station Footprint is located approximately 1.6 miles north of CR 110, the main road through the City of Hoyt Lakes. Hoyt Lakes' potable water is supplied from a 1.5 million gallon per day (MGD) surface water treatment plant located on the north end of the City near Colby Lake. The plant was constructed in 1954 and is considered to be in reasonably good condition. Raw water is supplied to the plant from two intakes located in Colby Lake. The intakes are set at different depths and the quality of the water dictates which intake is used to supply water to the plant. Treated water is pumped to a 1.7 million gallon standpipe located in the center of Hoyt Lakes, and to a 150,000 gallon elevated tower located west of the City in the Laskin Energy Park. A pumping station located at the standpipe can pump water to the elevated tower when the water treatment plant is not operating. The booster station has three pumps and can supply water to the elevated tower at a maximum rate of 1,200 gallons per minute (gpm). The elevated tower supplies water to Laskin Energy Park site and MP through a 12-inch distribution main.

Use of the Hoyt Lakes System would require construction of a 6-inch pipeline approximately 11,000 feet from the East Range IGCC Power Station to the 12-inch water main that serves MP. Figure 2.1-5 shows the preliminary routing of the water main. The proposed routing would require a portion of the water main to cross Colby Lake.

The average water use for the City of Hoyt Lakes is 275,000 gpd with maximum daily demands of 700,000 gpd. MP uses an average of 75,000 gpd or 100 gpm over a 24-hour day. This nominal usage allows for capacity in the existing 12–inch pipeline to supply the potable water requirement of 45,000 gpd to Mesaba One and Mesaba Two during construction and peak 7,500 gpd during normal operations. The proposed 6-inch pipeline will provide the required flow and pressure to Mesaba One and Two without the need for a booster station. The City of Hoyt Lakes treatment plant thus has the capacity to provide the potable water needs of Mesaba One and Mesaba Two.

The City of Hoyt Lakes would own and maintain the pipeline and the Applicant would enter into an agreement with the City to purchase water. The City would be responsible for maintaining the quality of the water and the operating and maintenance costs associated with the treatment equipment and distribution system.

3.6.4 Domestic Wastewater System

3.6.4.1 West Range Domestic Wastewater System

To dispose of domestic wastewaters produced by the IGCC Power Station, the Station will be connected to the Coleraine-Bovey-Taconite wastewater collection and treatment system. This will require constructing approximately 10,000 feet of 12-inch gravity sewer pipeline, a pump station, and 2,400 feet of force main from the Station Footprint, in a southerly direction, to the City of Taconite's main pump station located in the northeast corner of the City.

A construction ROW 50 feet wide and a permanent ROW 30 feet wide will be required, resulting in a total impact of approximately 14 acres and 8 acres, respectively. Figure 2.1-3 shows the route for the domestic wastewater sewer system to connect to the City of Taconite's system.

The 12-inch sewer pipeline, pump station, and force main would have ample capacity to convey the maximum projected wastewater flow of 45,000 gpd during construction (and the 7,500 gpd expected flows for the operational phase of Mesaba One and Two) and the existing Coleraine-Bovey-Taconite waste water treatment facility has capacity available to treat such quantities.

3.6.4.2 East Range Domestic Wastewater System

To dispose of domestic wastewater produced by the IGCC Power Station, the Station will be connected to the City of Hoyt Lakes' wastewater collection and treatment system. This would require constructing approximately 9,500 feet of 12-inch gravity sewer pipeline, a pump station, and about 2,500 feet of 4-inch force main. The wastewater piping will parallel the existing high voltage power line easement along the west side of the proposed property boundary, south to Colby Lake. A pump station will be located on the north side of Colby Lake. The force main would be directionally drilled beneath Colby Lake and then connected to the existing city gravity sewer near MP on the north end of Colby Lake Road. The 12-inch sewer pipe would have ample capacity to convey the estimated wastewater flow of 45,000 gpd during construction. The existing Hoyt Lakes wastewater treatment facility has capacity available to treat the estimated flow from the proposed project.

3.7 GENERATING PLANT CONSTRUCTION

Construction work will begin on the IGCC Power Station during early 2008 with work being completed in 2011.

Environmentally sensitive areas at construction sites will be identified in more detail prior to the start of construction. These locations will be clearly flagged and will not be disturbed during construction site preparation activities. Best Management Practices for control of storm water runoff and erosion protection will be installed and implemented during this time period.

Most construction activities are expected to occur during a single shift between the hours of 7 a.m. and 5:30 p.m., Monday through Saturday. Additional hours and/or a second shift may be necessary to make up schedule deficiencies or to complete critical construction activities. During the warm weather season, a second shift may be utilized to complete civil and other work activities. X-ray inspection, weld stress-relieving, and some production welding typically occurs during a second shift. Commissioning activities prior to initial plant startup will occur 24 hours per day.

3.7.1 General Construction Plans

The EPC contractor will be responsible for the design, procurement and construction of the facility. The following units within the IGCC Power Station will be constructed by the EPC contractor and subcontractors with work on elements occurring concurrently:

- Gasification and Gas Treating
- Power Block
- Air Separation Unit
- Feed and Product Handling
- Sulfur Recovery and Tail Gas Recycle
- Balance of Plant (Water treatment, Switchyards, Buildings, and Interconnecting Pipe Racks)

Work outside the battery limits of the plant is described in subsequent sections of this document.

Mobile trailers or modular offices will be used for owner, contractor and subcontractor personnel, and craft change and lunch areas. Trailers, parking, and material storage will be located within the planned construction site. Construction site access will be controlled for personnel and vehicles. A security fence will be installed around the construction site and other areas requiring security.

Construction material will be delivered to the site by truck and rail. It is expected that 15-20 semi trucks daily will be required to bring material to the site. The early completion of the rail spur will allow major plant equipment to be delivered to the site via rail shipment. Emergency services will be coordinated with the local fire departments, police departments, paramedics, and hospitals. There are major hospitals located in Grand Rapids, Hibbing and Duluth. A first aid office will be established on site for minor first aid incidents. Trained/certified Health, Safety and Environmental personnel will be continuously on site to respond to and coordinate emergencies.

All temporary facilities will have fire extinguishers, and fire protection will be provided in work areas where welding takes place.

During construction, temporary utilities will be provided for construction offices, craft change trailers, lay down areas and the construction areas. Temporary construction power will be provided by the local utility. On site generators may be used until the temporary power system is completed. Area lighting will be provided and strategically located for safety and security.

Local telecommunication lines will be brought in for telephone and information technology communications.

Temporary sanitation facilities will be provided and cleaned daily, with waste hauled to a local disposal facility.

Water bottles will be provided for drinking water and construction water will be supplied either by pumping and treatment of surface waters in the vicinity, or by connection to the local municipal water system.

Construction water use will be heaviest during the testing phase. Spent hydrotest water will be sampled and tested. If allowed by applicable regulations and permits, spent hydrotest water with suitable chemistry will be routed to the detention basin for disposal to local surface waters. If not suitable for routing to the retention basin, the water will be transported by truck to an appropriately licensed off-site treatment facility. See Section 3.4.4.2 for estimated quantities.

3.7.2 Phase II Construction

The preceding construction plan description generally applies to both Phase I and Phase II Developments. The Phase II portion of the IGCC Power Station will be installed in the equipment staging and lay down area utilized for Phase I construction and a new Phase II staging and lay down area will be prepared at the beginning of the Phase II work.

Detailed construction plans and specifications for Phase II will include provisions necessary to protect construction and plant operating personnel and equipment from potential impacts from the adjacent operating Phase I plant and to minimize IGCC operational disruption during Phase II construction.

Phase II construction work is expected to take place from spring 2010 to 2013.

3.7.3 West Range Construction

The West Range IGCC Power Station Footprint and Buffer Land is wooded and also contains several wooded and shrub wetlands. A new plant access road will be constructed off CR 7 and will be utilized for construction worker daily access and trucked material deliveries. It is expected that most traffic to the site will utilize Hwy 169 to access CR 7 and the plant entry.

The first activities will consist of constructing access roads, clearing brush and trees, leveling, grading, and dewatering construction sites (where appropriate), and bringing in utilities and undertaking other activities that are required to prepare the site for construction. Construction parking, temporary offices and material storage locations will be prepared at this time. Activities during this time period will involve the use of large earthmoving equipment needed to clear and prepare the site for construction. Trucks will remove harvested timber, unsuitable soils, and debris off site; haul in fill material for plant equipment areas and roadways; and stockpile additional fill material. Blasting will be required to remove subsurface rock formations during excavation and grading activities. Gravel and road base will be utilized for temporary roads, material storage, and parking areas. Temporary office plans and site parking areas for construction associated with the Phase II Development are described in Section 1.9 of the ES. Construction priority will be given to the rail spur so that plant equipment may be received on rail shipments as the Project progresses.

Surficial groundwater levels in soils at the West Range Site are likely to require measures beyond temporary construction dewatering. A permanent dewatering system will likely be needed to ensure long-term water table control at the facility site.

3.7.4 East Range Construction

The East Range Site is situated north of the City of Hoyt Lakes in St. Louis County, Minnesota. The proposed location of the plant contains some wooded and shrub swamps. Various site areas have been cleared of trees, and transmission lines exist along the west side of the property. The Duluth, Missabe and Iron Railway Co. (CN subsidiary) track runs along the east and south sides of the property.

Station access roads would be constructed off CR 666. These roads will be utilized for worker daily access and trucked material deliveries. It is expected that most of the construction traffic to the site will be from the west where some of the larger communities in the area of St Louis County are located.

It is also anticipated that large equipment required at the site will be shipped by rail. The Duluth, Missabe and Iron Range Railway Company has interchanges with all major railroads operating in Northern Minnesota and large equipment shipments will generally utilize rail service to the site. Equipment will also be trucked to the site when rail shipment is not feasible.

Similar to the West Range Site, the first site activities will consist of preparing the plot for construction of the facility. This work will involve constructing access roads, clearing brush and trees, dewatering, leveling and grading the site, and bringing in utilities. These activities will involve the use of large earthmoving equipment and potential blasting operations, depending on subsurface conditions. Trucks will haul in fill material for roadways, parking areas, and construction material storage areas. Construction parking, temporary offices, worker change trailers, and material storage locations very similar to those described for the West Range Site will be prepared at this time. Gravel and road base will be utilized for surfacing temporary roads, material storage, and parking areas. Construction priority will be given to the rail spur so that plant equipment may be received on rail shipments as the Project progresses.

Construction support facilities and Phase II construction considerations for the East Range alternate site would be very similar those previously described for the West Range Site.

4. TRANSMISSION LINE ENGINEERING AND OPERATIONAL DESIGN

This section describes the design of the proposed high voltage transmission lines required for the Project and its operation. The names attached to the plans and routes discussed in this section are provided in Table 2.2-1 in Section 2.2.2.3.

4.1 ELECTRICAL DESIGN CONSIDERATIONS AND SWITCHYARDS

4.1.1 Turbine Generator Output

Electric power for each of the two phases of the IGCC Power Station will be produced by two combustion turbine generators (about 220 MW each) and by one steam turbine generator (up to 300 MW). The voltage level characterizing the electrical output of the combustion turbine generator and steam turbine generator (16.5kV and 18kV, respectively) will be below the level needed to transmit the Station's net electric output to its POI. Transformation to the appropriate voltage will occur prior to the Power Station's switchyard. The design and cost of the IGCC Power Station are currently based on such transformation delivering to the switchyard at a voltage of 230kV.

4.1.2 Conductor Capacity and Generator Outlet HVTLs

Based on the Station's nominal net electric output of 606 MW at a 0.90 power factor, one bundled conductor 230kV transmission line rated at 1,585 Amperes is sufficient to carry the peak electrical output of Mesaba One or Mesaba Two. A single 345kV bundled conductor rated at 2,113 Amperes could carry the full 1,212 MW net electric power output from Mesaba One and Mesaba Two. However, a minimum of three 230kV HVTLs, two 345kV HVTLs, or a combination of two 230kV HVTLs and one 345kV HVTL would be required to satisfy the single failure criterion design element (that is, loss of one GO HVTL could occur without interrupting the Phase I and II IGCC Power Station's delivery of its peak output power to the POI).

4.1.3 Interconnection Voltage

The choice between transforming the output power of Mesaba One and/or Mesaba Two to 230kV or 345kV is not solely dependent upon the distance between the Power Station and its POI (although distance is important because power losses increase with increasing distance from the POI). The choice is also dependent upon voltage levels at which the substation currently operates (the electrical equipment required to transform power from one level to another is very expensive) and existing "down stream" power flow constraints.

4.1.3.1 Operating Voltage of Regional Electric Transmission System

The regional high voltage transmission system on the Iron Range operates mainly at 115kV and 230kV. Efforts to bolster Minnesota's ability to exchange power between regions and with fewer attendant losses will dictate that new transmission developments in the region operate at higher voltages. The Applicant believes that 345kV will be the future standard on which such transmission developments on the Iron Range and elsewhere will be focused and has based its decision for the IGCC Power Station's interconnection voltage on that premise. The results of MISO's Interconnection Studies (see Section 1.8.1.4, 1.8.1.5, and 1.8.2.1) will confirm whether the Applicant's decision regarding the likelihood of future 345 kV development at the two substations is appropriate.

4.1.3.2 Flexibility Required Pending MISO's Decision-Making

Until such time as MISO confirms its decision on the interconnection voltage for Mesaba One and Mesaba two, the Applicant is requesting an HVTL Route Permit that allows flexibility to change its West Range interconnection voltage plans (use of 345kV at the East Range Power Station is dictated due the increased power losses that would otherwise occur if the system was operated at 230kV). In Section 2.2.2, the Applicant identified two HVTL plans to deal with uncertainties related to MISO's decision-making on the West Range interconnection request. The first plan, identified as Plan A, is based on the presumption that future 345kV developments in Northern Minnesota are imminent. The second plan, defined as Plan B, is based on a potential MISO determination that the region's electrical transmission system is best served by maintaining the Blackberry Substation's electrical connections to the grid at 230kV. If MISO decides otherwise, the addition of a 345kV bus at the substation is likely and the Applicant would implement Plan A (see Section 2.2.2 for a detailed explanation of the Applicant's Preferred Plan A and Contingent Plan B).

4.1.3.3 IGCC Power Station Developments Required to Operate At 345kV

The layout of the IGCC Power Station switchyard is shown in Figures 4.1-1 and 4.1-2. This layout is applicable to both West and East Range developments. Increasing the voltage at which the IGCC Power Station delivers its output power to the POI will require the addition of a 345kV bus at the POI and autotransformers at the Station's switchyard.

4.1.4 West Range Switchyard

4.1.4.1 Plan A

Phase I and II Developments would include interconnecting to the POI with two 345kV HVTLs placed on single steel pole structures and initially operating at 230kV during Phase I. The length of the radial HVTLs required to reach the Blackberry Substation from the southern boundary of the Buffer Land is approximately 8.5 miles. The line losses associated with operation of the 345kV GO HVTLs at 230kV are acceptable and therefore 230kV represents the preferred interconnection voltage for Mesaba One. To avoid increased power losses that would occur upon start up of Mesaba Two, the interconnection voltage will be converted to 345kV commencing with its operation.

The electrical layout of the switchyard for Mesaba One is currently designed for 230kV. Prior to commencing operation of Mesaba Two, additional autotransformers, a 345kV busbar and associated breakers will be added to the IGCC Power Station's switchyard to convert the Phase I GO facilities outlets to 345kV operation. The switchyard serving Mesaba Two will connect that unit's generators to one of the two 345kV GO HVTLs delivering the IGCC Power Station's output power to the grid. Figure 4.1-3 shows the configuration of the West Range IGCC Power Station switchyard commencing with operation of Mesaba Two.

Figure 4.1-1 Conceptual One Line Diagram for West Range and East Range Sites Depicting 230kV Switchyard

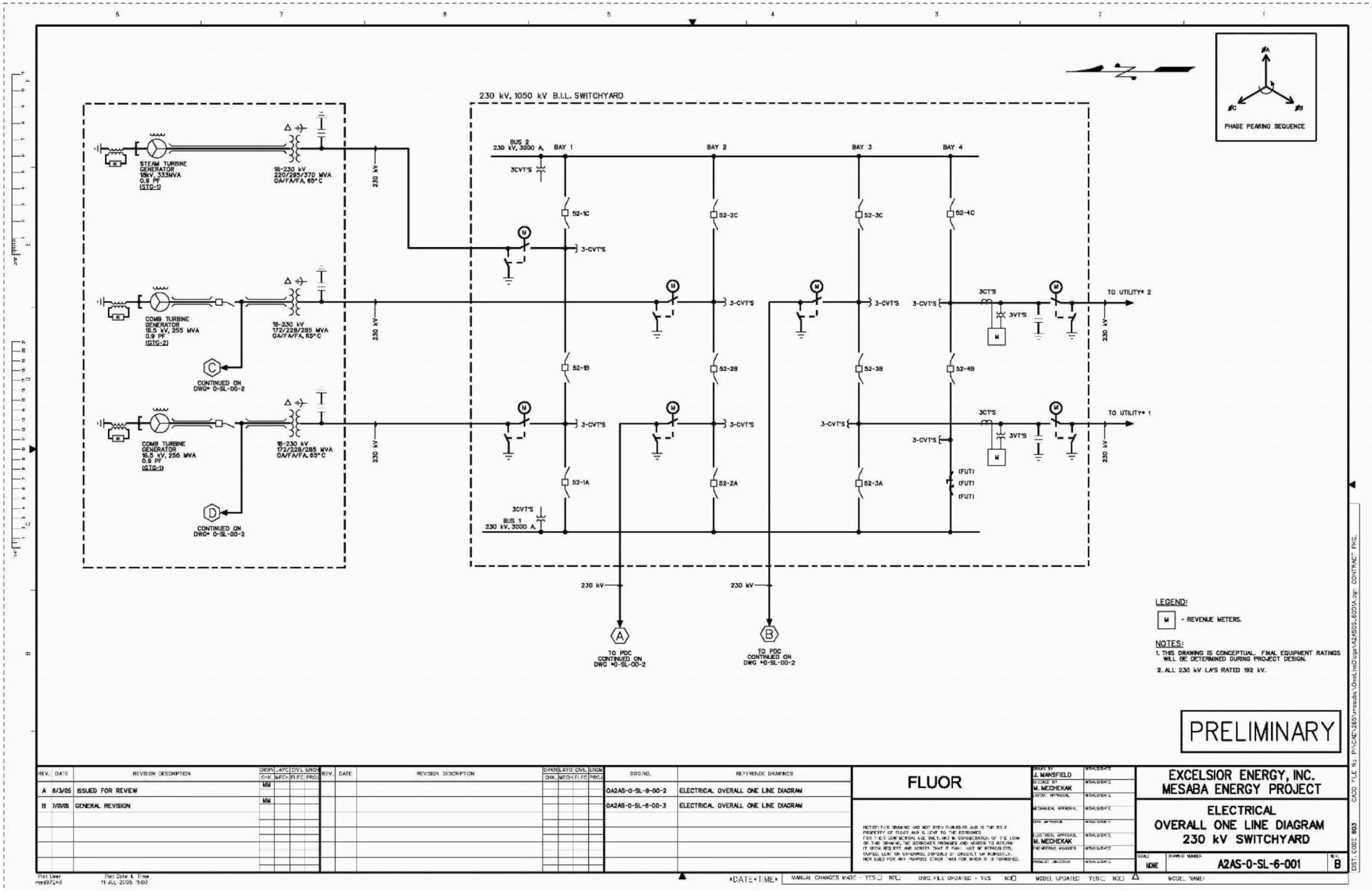


Figure 4.1-2 Conceptual One Line Diagram for West Range and East Range Sites Depicting 230kV Feeds to ASU, Power Block, and IGCC Substation

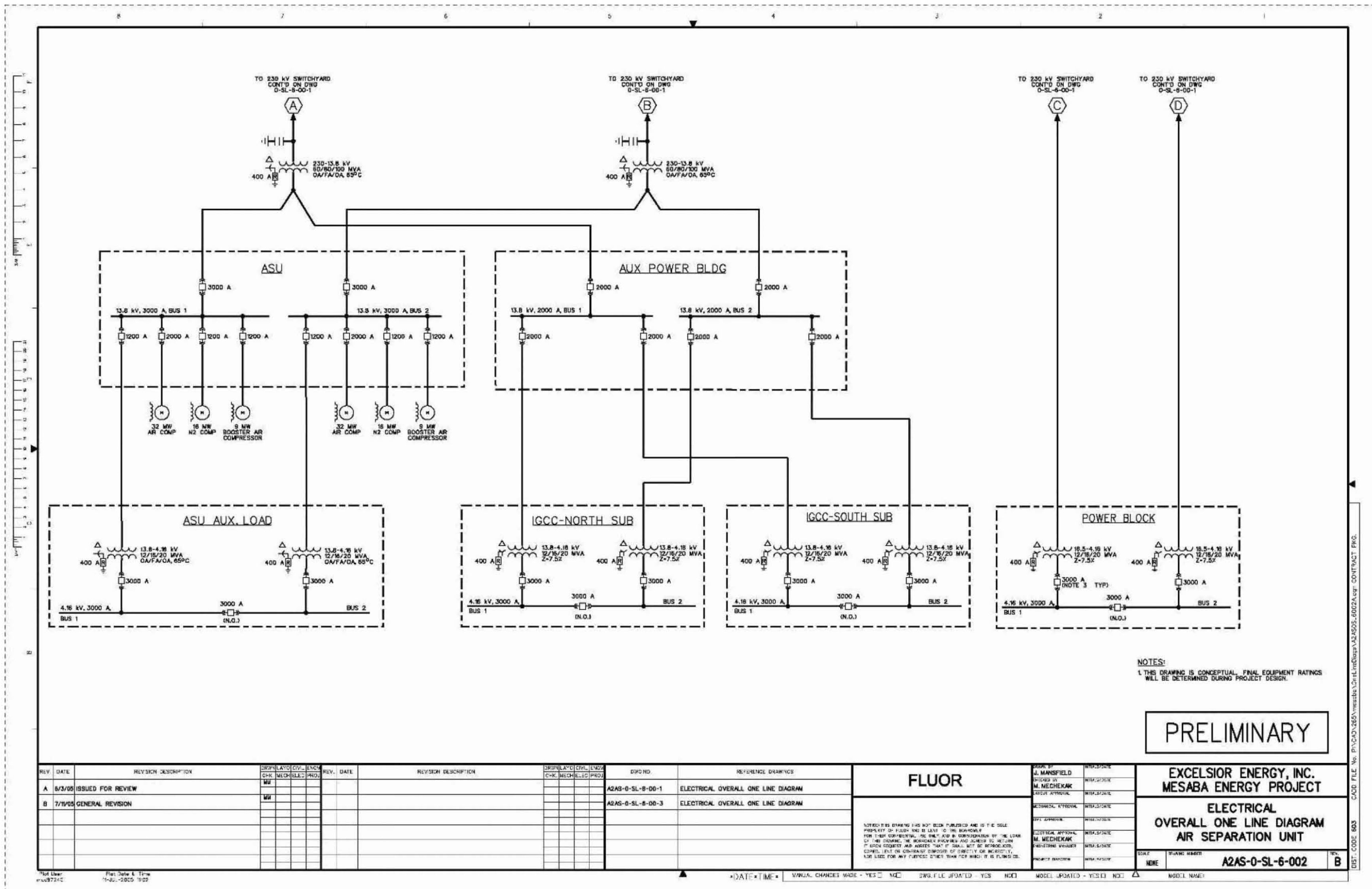
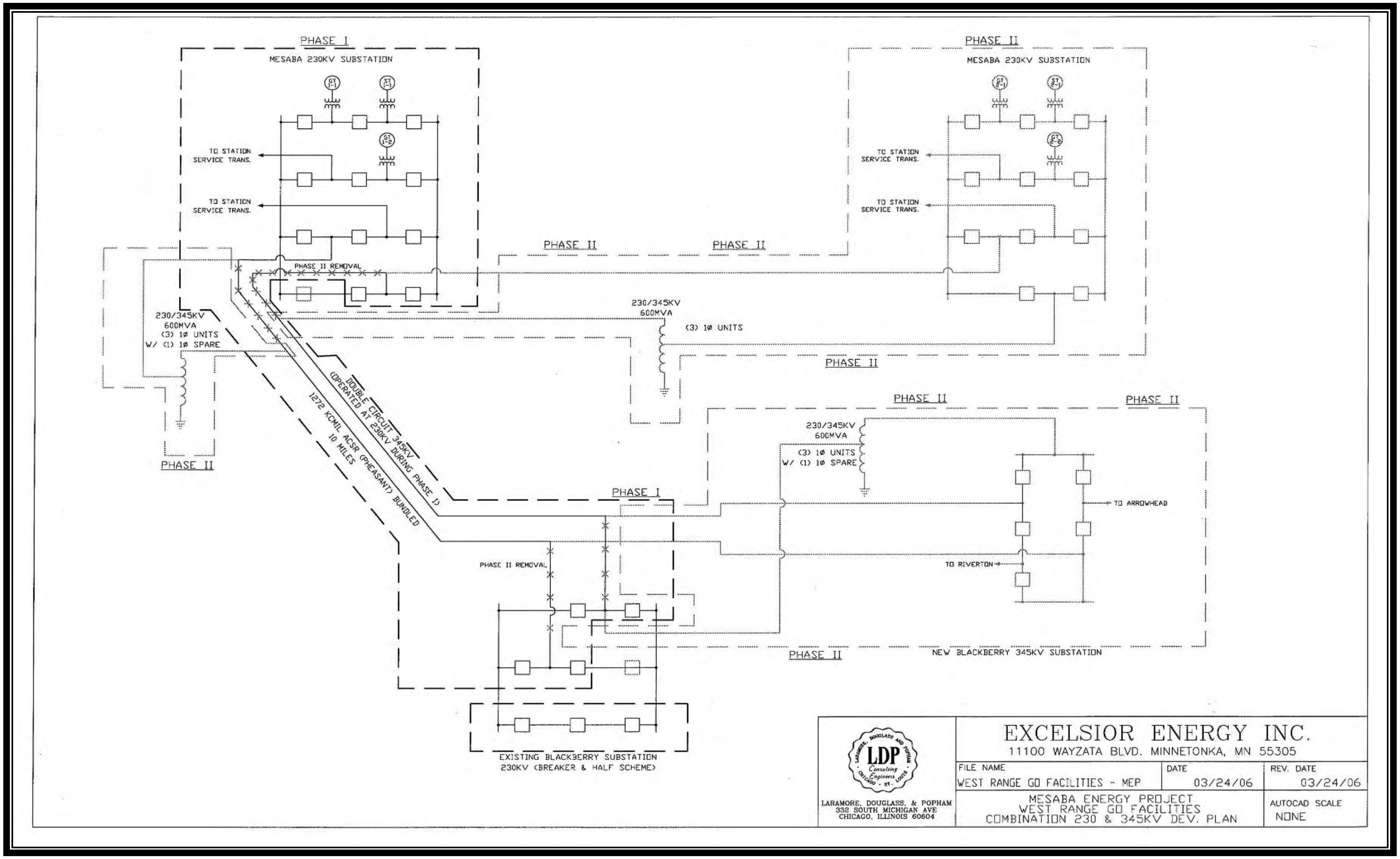


Figure 4.1-3 West Range Plan A Phase I and II IGCC Power Station Switchyard Design



4.1.4.2 Plan B

4.1.4.2.1 Plan B Phase I Preferred Route (WRB-1)

Phase I Developments under Plan B would include interconnecting to the POI with two 230kV HVTLs placed on single steel pole structures. As previously noted, these double circuited lines would not be sufficient to meet the single failure criterion with the addition of Mesaba Two.

The output voltage rating of the single HVTL required to provide the necessary redundancy for the Phase II developments would depend upon the route identified through the PPSA process. The preferred Route WRB-2 would allow the Phase II HVTL to be developed at 230kV. The alternate Route WRB-2A would require the Phase II HVTL to be developed at 345kV. As noted in the following two subsections, these two options would require different substation designs.

4.1.4.2.2 Plan B Phase II Preferred Route WRB-2

The switchyard design assuming the preferred route (for Phase II) is approved during the PPSA process is shown in Figure 4.1-4.

4.1.4.2.3 Plan B Phase II Alternate Route WRB-2A

The switchyard design assuming the alternate route (for Phase II) is approved during the PPSA process is shown in Figure 4.1-5.

4.1.5 East Range IGCC Power Station Switchyard

The high voltage switchyard for the East Range IGCC Power Station will be configured at 345kV to serve Mesaba One. The decision to operate the switchyard at 345kV commencing with startup of Mesaba One is based on net line losses totaling about 5 MW less than that which would otherwise occur if the GO facilities were operated at 230kV (losses of 3.5 MW compared with 8.4 MW for the 230kV approach). Over the project life, the capacity gain associated with 345kV development relative to the 230kV option more than offsets the 345kV development's higher capital cost.

The high voltage switchyard required to transmit the entire output from Mesaba One and Mesaba Two to the POI with minimum line losses will be installed to serve Mesaba One. Although work will be required in the switchyard to connect Mesaba Two to the GO HVTLs and to provide station power back to Mesaba Two, no further development of the GO HVTLs will be required.

The East Range IGCC Power Station switchyard design is shown in Figure 4.1-6.

Figure 4.1-4 West Range Plan B Phase II Preferred Route (WRB-2) IGCC Power Station Switchyard Design

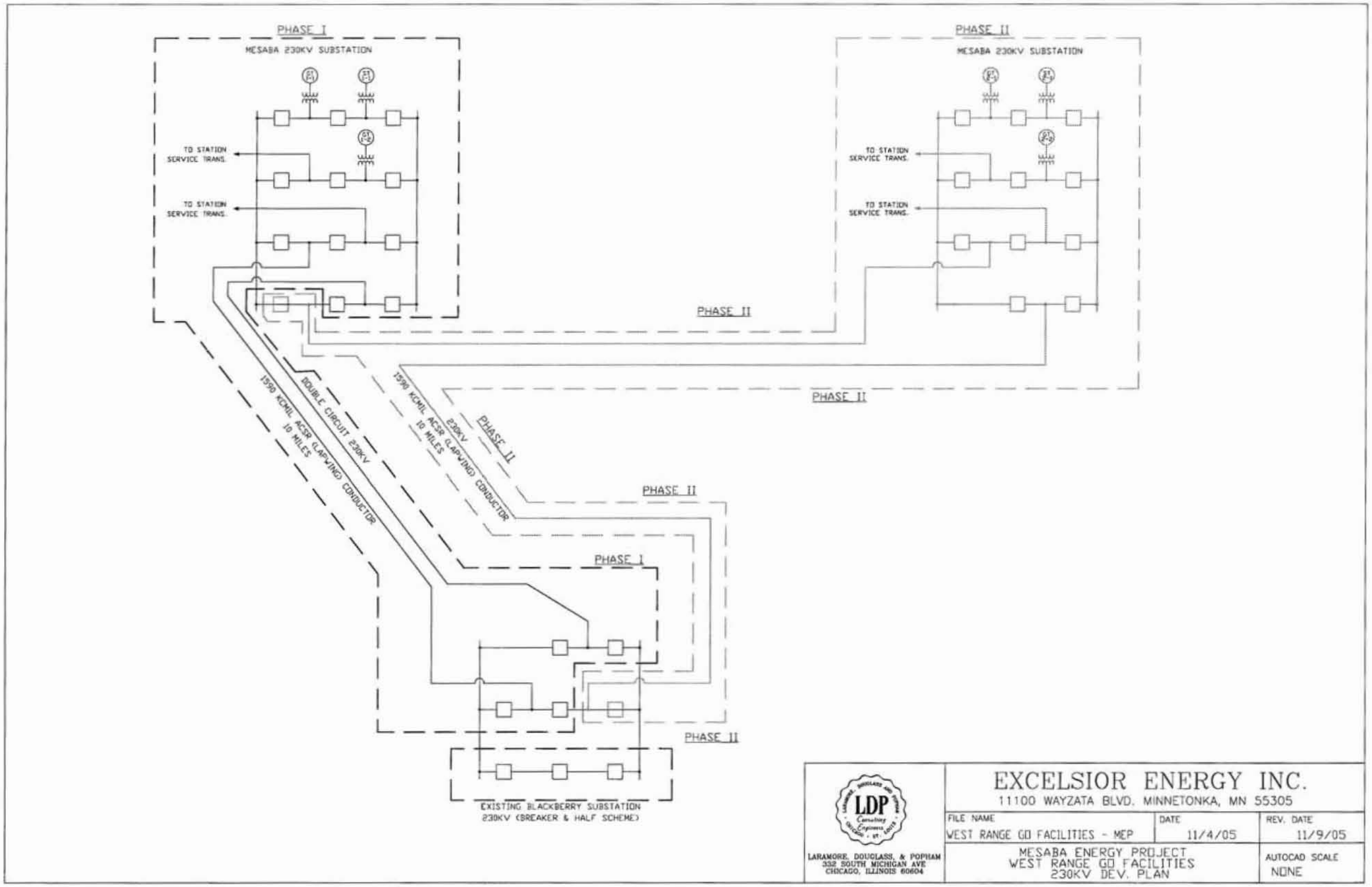


Figure 4.1-5 West Range Plan B Phase II Alternate Route (WRB-2A) IGCC Power Station Switchyard Design

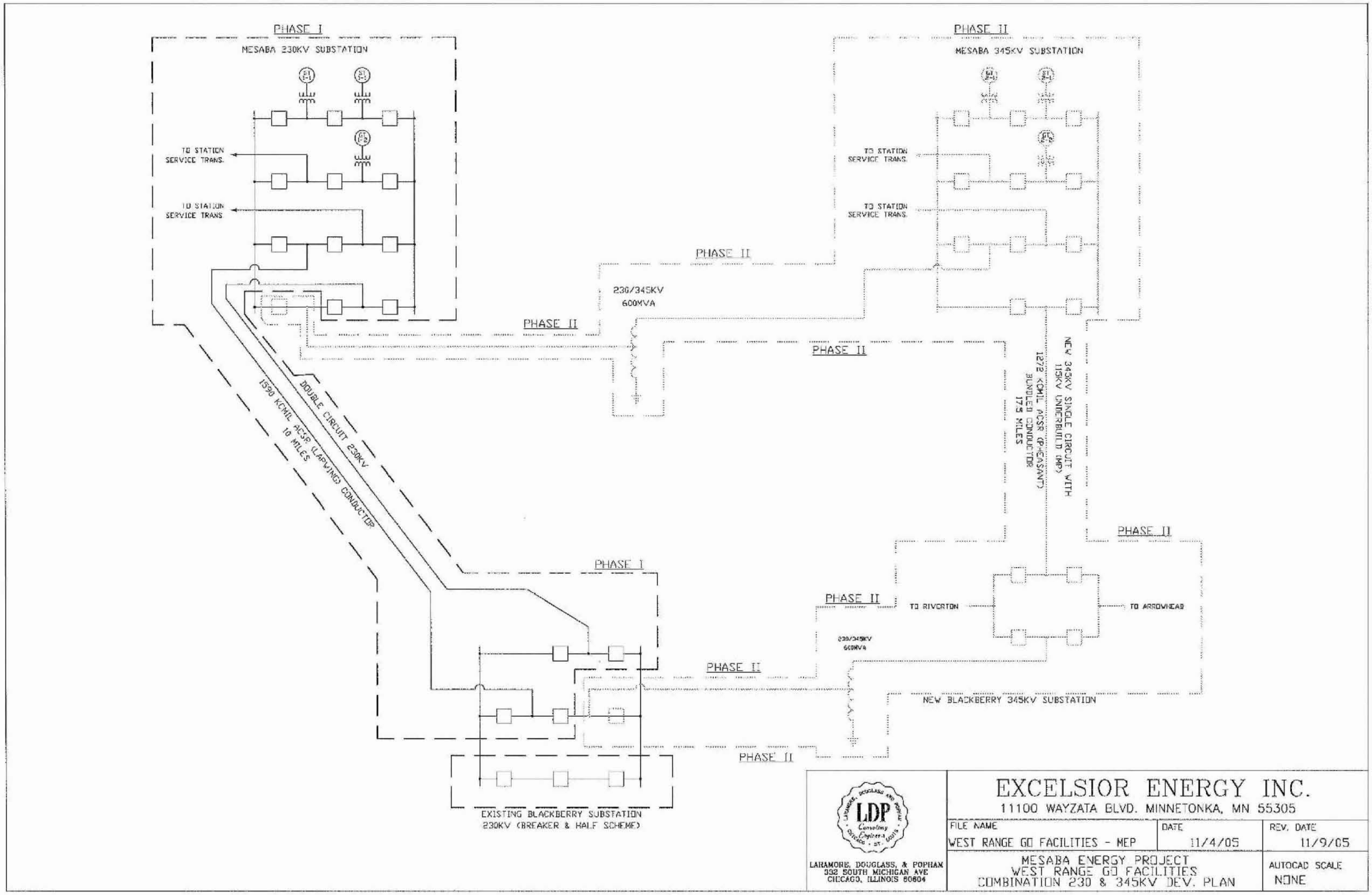
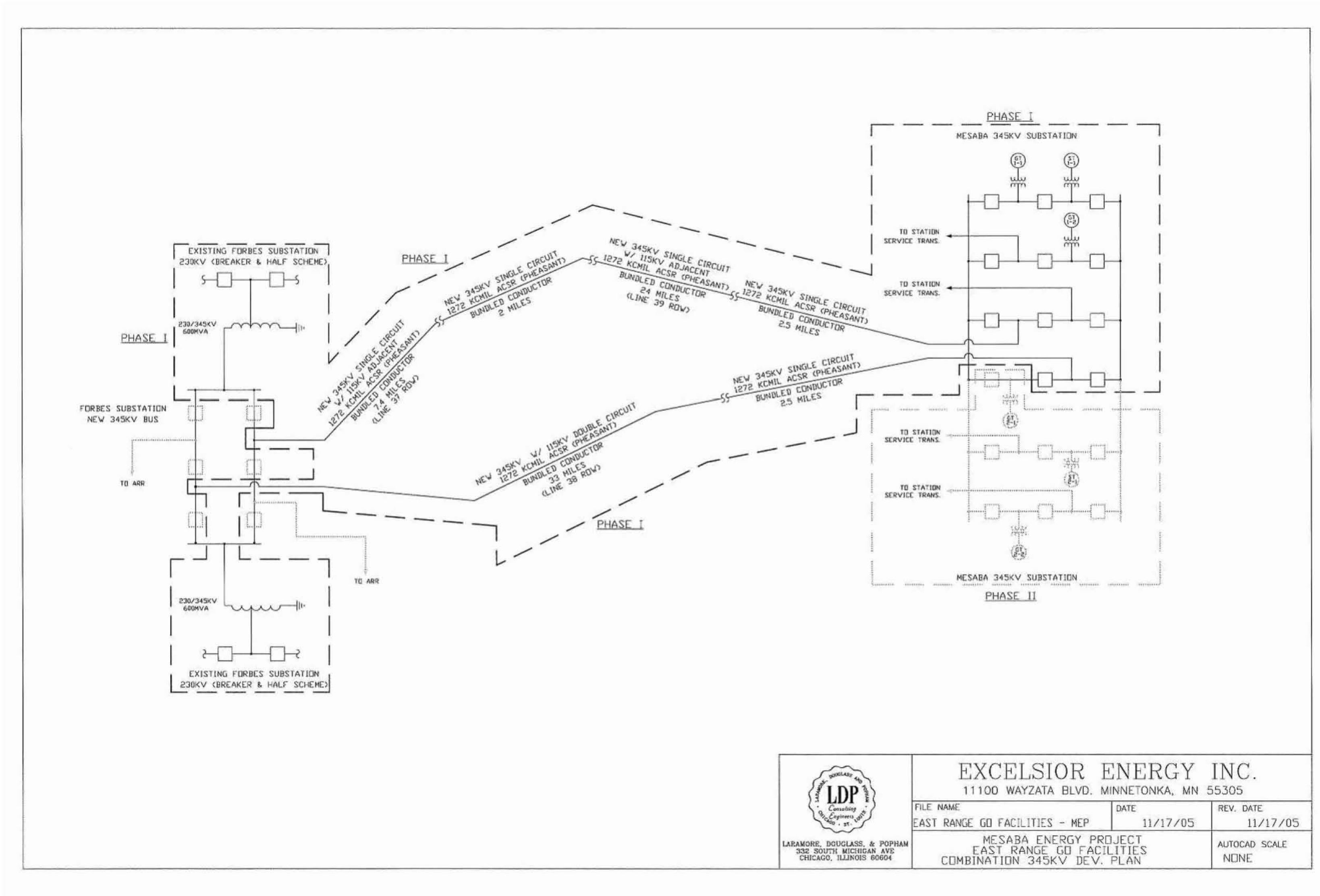


Figure 4.1-6 East Range IGCC Power Station Switchyard Design



4.2 GENERATOR OUTLET ROUTES: SPECIAL CONSIDERATIONS

4.2.1 West Range Site

4.2.1.1 Preferred Plan A

As noted, the proposed approach to providing generator outlets for the West Range Site consists of constructing a double circuit 345kV HVTL from the IGCC Power Station to the Blackberry Substation, operating such HVTLs at 230kV for Phase I, and thereafter converting the operating voltage of both circuits to 345kV for Phase II. This approach offers, at a relatively small marginal cost, the needed redundancy to meet the single failure criterion and accommodate the entire output of Mesaba One and Mesaba Two though use of just two HVTLs.

Wherever practical, the Applicant has sought to use existing routes for the GO HVTLs. Whenever the GO HVTLs are routed along existing HVTL corridors with active HVTLs present, the 345kV double circuit HVTL structures would be configured to carry existing HVTLs (the configuration and dimension of such structures is presented in Section 4.3).

The Plan A preferred Route WRA-1 and alternate Route WRA-1A are shown in Figure 2.2-1 and special considerations are described in the paragraphs below.

4.2.1.1.1 Preferred GO HVTL Route (WRA-1)

Figures 2.5-3 through 2.5-5 show the preferred Route WRA-1 for Plan A. This double circuit 345kV option would travel east from the Phase I IGCC Power Station's switchyard about 9.8 miles to MP's existing 45L ROW and then follow existing ROW south about 1.6 miles to the retired Greenway Substation. The HVTL route would continue south on double circuit 345kV structures approximately 6.2 miles from the Greenway Substation over new ROW to intersect MP's 83L and 20L. The route would follow the existing MP ROW about 1.1 miles east to the Blackberry Substation using a double circuit 345kV line with 115kV under build to carry the 20L along. This route provides a direct path between the IGCC Power Station and the POI, traverses mostly remote areas, and minimizes impacts on residences. The double circuit configuration of the structures requires the narrowest ROW width for two circuits. This smaller ROW footprint results in less tree trimming, less easement cost and generally has fewer landowner impacts when compared to other configurations. Special considerations along this route appear to be minimized given the remote nature of the surroundings, minimal number and length of water crossings, and generally level topography.

The new ROW traverses both forested areas and wetlands. Tree clearing will be required along the forested portion and special considerations will need to be applied to the wetland areas. Easements must be negotiated with several property owners, at which time the routing may be subject to minor changes. The existing, but abandoned, section of 45L will be removed. The 115kV 20L must be overbuilt or moved to the existing cross arms under the 83L. The line changes in the 83L/20L ROW will likely result in one mile of taller transmission structures for the double circuit 345kV line with its 115kV underbuild. The only disadvantage of the Plan A 345 kV double circuit is that it will afford less route diversity than two separate circuits on individual ROWs. However, the slight disadvantage is overcome by the many advantages the 345kV plan offers.

The structures to be used along preferred Route WRA-1 are identified in Section 4.3.1.1.

4.2.1.1.2 Alternate HVTL Route (WRA-1A)

Figures 2.5-6 through 2.5-8 show the alternate Route WRA-1A. This route is described in Section 2.5.3.1.2. Special considerations along this route include an increased number and length of crossings of the Swan River, topographical challenges where hills meet open water, and an increased number of spans across open areas (these areas include cleared fields and gravel mining operations).

In general, the double circuit structures carrying the two 345kV HVTLs on the alternate Route WRA-1A will be identical to those used in the Plan A preferred route.

4.2.1.1.3 Plan A Routing Summary

Table 4.2-1 below compares the preferred and alternate routes considered under Plan A.

Table 4.2-1 West Range Transmission Line Design Summary: Plan A

<table>
<tr><th>HVTL SEGMENT DESCRIPTION</th><th>EXISTING HVTL RATING</th><th>EXISTING CORRIDOR WIDTHS</th><th>APPROX. LENGTH</th><th>WIDENING OR NEW CORRIDOR NEEDED?</th><th>HVTL STRUCTURE TYPE</th><th>CONDUCTOR TYPE</th></tr>
<tr><td colspan="7">Preferred 345kV Route WRA-1 (see Figure 4.3-3)</td></tr>
<tr><td>45/28L</td><td>115Kv</td><td>145 ft</td><td>1.6 miles</td><td>No</td><td rowspan="3">See Figures 4.3-4, 4.3-4, and 4.3-6</td><td rowspan="3">1272 KCMIL ACSR (Pheasant) Conductor</td></tr>
<tr><td>82/20L</td><td>230kV</td><td>150 ft</td><td>1.0 miles</td><td>No</td></tr>
<tr><td>New ROW between Greenway & Blackberry Substations</td><td>Not Applicable</td><td>Not Applicable</td><td>6.3 miles</td><td>100 ft; 150 ft when sharing ROW with natural gas pipeline</td></tr>
<tr><td colspan="7">Alternate 345 kV Route WRA-1A (see Figure 4.3-7)</td></tr>
<tr><td>45/28L</td><td>115Kv</td><td>145 ft</td><td>1.6 miles</td><td>No</td><td rowspan="3">See Figures 4.3-4, 4.3-5, and 4.3-6</td><td rowspan="3">1272 KCMIL ACSR (Pheasant) Conductor</td></tr>
<tr><td>62L/63L</td><td>230kV</td><td>150 ft</td><td>0.9 miles</td><td>No</td></tr>
<tr><td>New ROW between Greenway & Blackberry Substations</td><td>Not Applicable</td><td>Not Applicable</td><td>5.8 miles</td><td>100 ft; 150 ft when sharing ROW with natural gas pipeline</td></tr>
</table>

4.2.1.2 Contingent Plan B

If the Applicant must abandon Plan A as a result of MISO's Interconnection Studies, it will implement Plan B developments as identified in Table 4.2-2 below. The basis for these options is described in the narrative presented in the subsections below.

Table 4.2-2
Plan B HVTL Routing Options

Route Name (see Table 2.2-1)	Plan B Phase I and II Routing Options		
	Preferred Option 1 (see Figures 2.2-2 and 4.3-8)	Alternate Option 2 (see Figure 2.2-3)	Alternate Option 3 (see Figure 2.2-4)
WRB-1	Phase I		Phase I
WRB-1A or WRB-2	Phase II (WRB-2)	Phase I (WRB-1A)	
WRB-2A		Phase II	Phase II

4.2.1.2.1 Phase I

4.2.1.2.1A Preferred Route (WRB-1)

The Plan B preferred Route WRB-1 is identical to the preferred Plan A Route WRA-1 with the exception that 230kV HVTLs will be used to deliver output power from Mesaba One to the POI. The double circuit 230kV structures will be shorter in height by approximately 30 ft (110 ft for the 230kV structures vs. 140 ft for the 345kV structures). The double circuit 230kV with underbuild will be shorter by the same amount (125 ft for the 230kV structures vs. 155 ft for the 345kV structures). The structure summary is provided in Figure 4.3-9 along with the appropriate ROW calculations for each structure in Figures 4.3-11 and 4.3-12.

4.2.1.2.1B Phase I Alternate Route (WRB-1A)

The Plan B Phase I alternate Route WRB-1A is identical to the alternate Plan A Route WRA-1A with the exception that 230kV HVTLs will be used to deliver output power from Mesaba One to the POI. The structures for this route are identical in configuration to those shown in Figure 4.3-9.

Table 4.2-3 West Range Transmission Line Design Summary: Plan B Phase I

HVTL SEGMENT DESCRIPTION	EXISTING HVTL RATING	EXISTING CORRIDOR WIDTHS	APPROX. LENGTH	WIDENING OF CORRIDOR NEEDED?	HVTL TOWER TYPE	CONDUCTOR TYPE
Preferred 230kV Route WRB-1 (see Figure 2.2-2)						
45/28L	115Kv	145 ft	1.6 miles	No	See Figures 4.3-11 and 4.3-12	1590 KCMIL ACSR (Lapwing) Conductor
82/20L	230kV	150 ft	1.0 miles	No		
New ROW between Greenway & Blackberry Substations	Not Applicable	Not Applicable	6.3 miles	100 ft; 150 ft when sharing ROW with natural gas pipeline; 150 ft when two structures occupy one corridor		
Alternative 230 kV Route WRB-1A (see Figure 2.2-2)						
45/28L	115Kv	145 ft	1.6 miles	No	See Figures 4.3-11 and 4.3-12	1590 KCMIL ACSR (Lapwing) Conductor
62L/63L	230kV	150 ft	0.9 miles	No		
New ROW between Greenway & Blackberry Substations	Not Applicable	Not Applicable	5.8 miles	100 ft; 150 ft when sharing ROW with natural gas pipeline; 150 ft when two structures occupy one corridor		

4.2.1.2.2 Phase II

4.2.1.2.2A Preferred Route (WRB-2)

The Plan B Preferred Route WRB-2 will be the route not selected for Phase I as noted above in Section 4.2.1.2.1. The ROW calculation for the double circuit and the single circuit structures sharing the same corridor are shown in Figure 4.3-10. The ROW calculations for the separate single circuit structure are shown in Figures 4.3-13 and 4.3-14.

4.2.1.2.2B Alternate Route (WRB-2A)

If the Plan B Preferred Route WRB-2 for Phase II is not selected, the Applicant will use two existing corridors with a combined length almost twice that required to reach the POI using the preferred route (about 18 miles in length versus 9 miles in length for the preferred route). Because of the increased length of this route to the POI, a 345kV HVTL rated at 1,212 MW would be required to avoid significant line losses and power flow imbalances.

The 345kV Alternate Route WRB-2A would travel east from the Phase I and II IGCC Power Station to the 45L corridor and then north about 1.2 miles from the point of intersection on single circuit wood “H” frame or delta structures to the point where it intersects with 28L. The route would then follow 28L east approximately 7.8 miles to a point nearby the intersection of 28L and 62L just north of Pengilly. At this point, a short new ROW will be required (see Figure 4.3-15 and the following paragraph). The Applicant’s new HVTL would then travel southwest approximately 6.7 miles to the Blackberry Substation on single circuit 345kV delta configured structures with a 115kV underbuild to carry 62L. Utilization of the alternate route would provide route diversity as it is completely separated from the 230kV double circuit route specified under either of the Plan B Phase I alternatives (see Figure 2.2-2 to view the Plan B Phase I alternatives).

The width of the ROW associated with the existing 28L corridor is currently 145 feet. The width of the ROW for the 62L/63L corridor varies between 160 and 340 feet for most of its length (see Figure 4.2-1). A 0.7 mile segment of the 62L/63L corridor located about 3.7 miles from the Nashwauk Substation narrows significantly and will require special towers and new ROW to carry the lines traversing this segment. Figure 4.2-1 illustrates how the 62L/63L ROW varies as a function of distance from the Nashwauk Substation. This is the only special consideration along this existing route. The structure summary for the Plan B Phase II Alternate Route WRB-2A is shown in Figure 3.4-16. The ROW calculations for the 345kV double circuit structures are provided in Figures 4.3-17, 4.3-18a, and 4.3-18b.

4.2.1.2.3 Plan B Phase II Routing Summary

Table 4.2-4 below compares the preferred and alternate routes considered under Plan B.

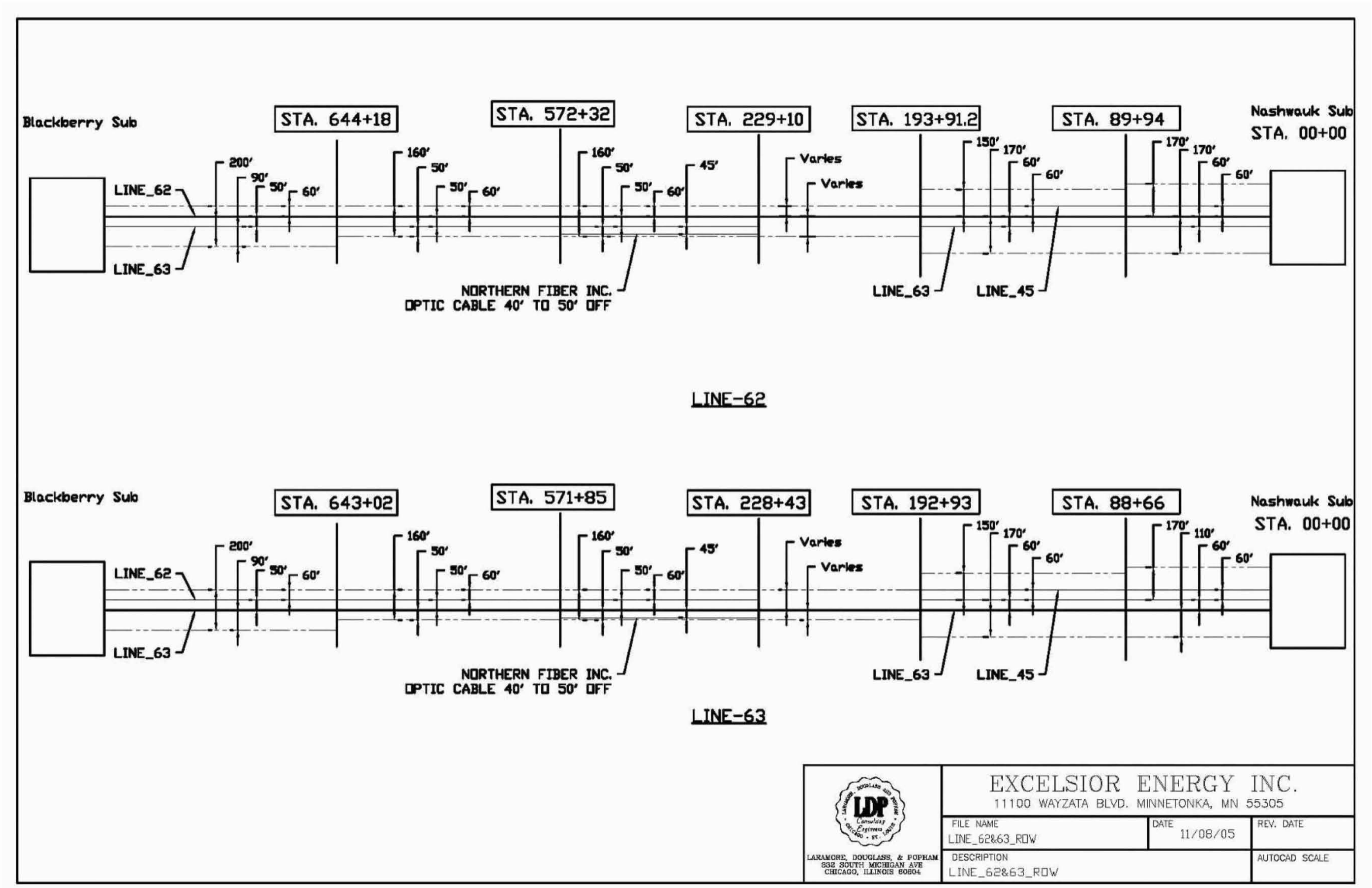
Table 4.2-4
West Range Transmission Line Design Summary: Plan B Phase II

<table>
<tr><th>HVTL SEGMENT DESCRIPTION</th><th>EXISTING HVTL RATING</th><th>EXISTING CORRIDOR WIDTHS</th><th>APPROX. LENGTH</th><th>WIDENING OF CORRIDOR NEEDED?</th><th>HVTL TYPE</th><th>CONDUCTOR TYPE</th></tr>
<tr><td colspan="7">Preferred 230kV Route WRB-2 (Figure 4.3-8)</td></tr>
<tr><td>45/28L</td><td>115Kv</td><td>145 ft</td><td>1.6 miles</td><td>No</td><td rowspan="3">See Figures 4.3-13 and 4.3-14</td><td rowspan="3">1590 KCMIL ACSR (Lapwing) Conductor</td></tr>
<tr><td>62L/63L</td><td>230kV</td><td>150 ft</td><td>0.9 miles</td><td>No</td></tr>
<tr><td>New ROW between Greenway & Blackberry Substations</td><td>Not Applicable</td><td>Not Applicable</td><td>5.8 miles</td><td>100 ft; 150 ft when sharing ROW with natural gas pipeline; 150 ft when two structures occupy one corridor</td></tr>
</table>

HVTL SEGMENT DESCRIPTION	EXISTING HVTL RATING	EXISTING CORRIDOR WIDTHS	APPROX. LENGTH	WIDENING OF CORRIDOR NEEDED?	HVTL TYPE	CONDUCTOR TYPE
OR (Figure 2.2-4)*						
45/28L	115Kv	145 ft	1.6 miles	No	See Figures 4.3-13 and 4.3-14	1590 KCMIL ACSR (Lapwing) Conductor
82/20L	230kV	150 ft	1.0 miles	No		
New ROW between Greenway & Blackberry Substations	Not Applicable	Not Applicable	6.3 miles	100 ft; 150 ft when sharing ROW with natural gas pipeline; 150 ft when two structures occupy one corridor		
Alternate 345 kV Route WRB-2A (Figure 4.3-15)						
45/28L	115kV	145 ft	8.8 miles	No	See Figures 4.3-15, 4.3-17, 4.3-18a and 4.3 18b	1272 KCMIL ACSR (Pheasant) Conductor
62/63L	115kV	160-340 ft	8.7 miles	No		
New ROW 28L between 62L/63L	Not Applicable	Not Applicable	0.5miles	100 ft		

*This route is unlikely because it represents the overall preferred route for Plan Phase I. That said, it is shown as a potential selection in Phase II for the sake of completeness

Figure 4.2-1 ROW Widths Along Existing 62L/63L HVTL Corridor



4.2.1.3 East Range Site

The proposed approach to providing generator outlet facilities for the East Range Site consists of constructing two new 345kV HVTLs from the IGCC Power Station to the Forbes Substation. Both new lines will be constructed during Phase I to meet the single failure criterion and provide the capacity to meet the GO requirements for both Mesaba One and Mesaba Two. Each line would follow existing 115kV HVTLs (39L/37L and 38L) along most of their length. Where the new HVTLs parallel existing HVTLs, the existing HVTLs would be transferred to the new HVTL structures, resulting in new single structure, double circuit (345kV/115kV) HVTLs. The proposed transmission line routes are shown in Figure 2.2-5. Table 4.2-1 includes a summary of the East Range transmission line design information under this generator outlet approach.

Table 4.2-1
East Range Transmission Line Design Summary

HVTL SEGMENT DESCRIPTION	EXISTING HVTL RATING	EXISTING CORRIDOR WIDTHS	APPROX. LENGTH	WIDENING OF CORRIDOR NEEDED?	HVTL TOWER TYPE & NUMBER	CONDUCTOR TYPE
43L Route						
New ROW parallel to 43L	NA	NA	2.5 miles	100 feet	See Figure 3.4-5	1272 KC MIL ACSR (Pheasant conductor)
Preferred 39L/37L Route						
39L	115kV	100 feet	23.6 miles	30 feet	See Figures 4.3-23b, 4.3-24a, 4.3-24b, and 4.3-25	1272 KC MIL ACSR (Pheasant conductor)
New ROW		Not Applicable	2.0	100 feet		
37L	115kV	100 feet	7.4 miles	100 ft		
38L Route						
38L	115kV	100 feet	33.0	No	See Figures 4.3-17 and 4.3-18a & b	1272 KC MIL ACSR (Pheasant conductor)

The 345kV HVTLs would be constructed along the existing 38L and 39L/37L HVTL routes minimize environmental impacts associated with the development of new ROWs. The proposed construction sequence for the preferred route is as follows.

- The Applicant will acquire an additional 30 feet of ROW along the entire length of the existing 39L/37L HVTL.
- Using the additional ROW width, the Applicant will construct a structure type that allows for the MP 115kV lines (39L and 37L) to be transferred to an available circuit position on the steel pole paralleling the 345kV position. The initial 345kV circuit would be installed and energized at 115kV.

- After the first circuit is energized at 115kV, the "H" Frame structures on the 39L/37L ROW would be removed, and an additional circuit of 115kV would be installed in the open circuit position paralleling the 345kV conductor.
- The energizing of the second 115kV circuit will allow for the de-energizing and removal of the existing 38L 115kV line, and the subsequent construction of the second new 345kV/115 kV double-circuit line within the existing 38L ROW.
- After construction of the two new lines is completed, each line would be energized with 345kV/115kV double-circuits. The net increase will be two new 345kV lines to provide the necessary GO for the East Range IGCC Power Station.

If the alternate route is selected the construction sequence would be similar, with the actions on the 39L/37L and 38L lines reversed.

4.3 STRUCTURES AND RIGHT-OF-WAY REQUIREMENTS

The Applicant is proposing to use single steel pole structures along most of its transmission line segments. The foundation design for these structures is provided in Figure 4.3-1. Different foundations are needed in poorly drained, compressible soils. In such instances foundations similar to that presented in Figure 4.3-2 will be used.

Steel light duty "H" frame structures may be proposed for a portion of the transmission line segments on the Buffer Land and/or where other demands warrant their placement (see Section 4.3.1.3). The selection of structure type and required height are dictated by the line voltage, the number of circuits carried by the structure, clearance requirements, environmental impacts, and economic considerations. Right-of-way requirements are dependent on the structure configuration and are described in this section.

4.3.1 West Range

4.3.1.1 Plan A

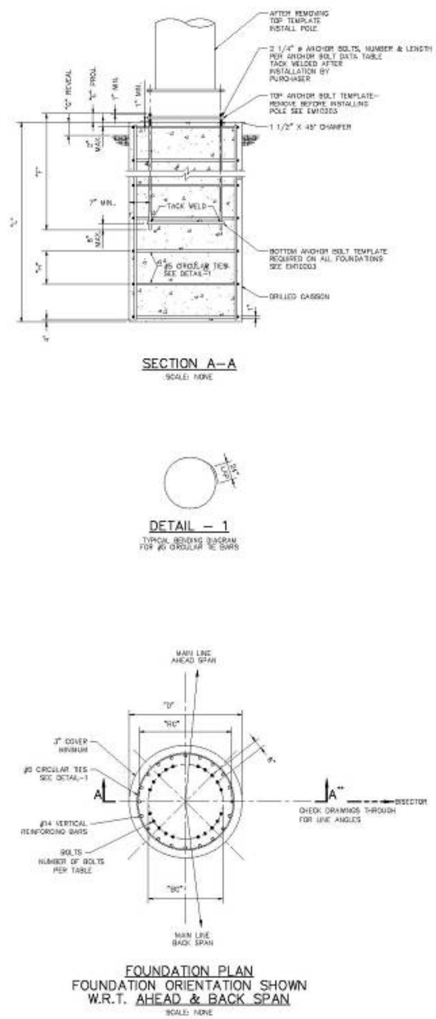
4.3.1.1.1 Preferred Route WRA-1

Figure 4.3-3 shows the 345kV double circuit preferred route line segments. A preliminary summary of the HVTL structure configurations and heights that would be used along the 345kV preferred Route WRA-1 are provided in Figure 4.3-4. A detailed analysis showing the ROW required for each of the structures and the dimensions upon which the ROW calculation is based is provided in Figure 4.3-5 and Figure 4.3-6. The height of the new structures would exceed that of the existing "H" frame 115kV towers by a maximum of 70 to 85 feet depending upon which double circuit configuration is utilized (that is, double circuit or double circuit with underbuild).

4.3.1.1.2 Alternate Route WRA-1A

Figure 4.3-7 shows the 345kV double circuit alternate route line segments. The summary of the HVTL structure configurations and heights that would be used along the 345kV Alternate Route WRA-1A are provided in 4.3-3 (the structures are identical in configuration to those used for the Preferred Route WRA-1, but would number a few less).

Figure 4.3-1 Single Pole Steel HVTL Structure Foundation Design



ANCHOR BOLT DATA							FOUNDATION DETAIL				
NO. OF BOLTS 2 1/4" DIA.	NO. OF # 14 VERTICAL RE-BARS	DIMENSIONS "BC"	"E"	"F"	"G"	"H"	CAISSON DIAM. "D"	OVERALL LENGTH "L"	SPACING BETWEEN BOLTS ON "BC"	DIAM. "RC"	CLEAR SPACING BETWEEN RE-BARS ON "RC"
44	40	81	1"	120"	1'	18"	10'	40.5'	6"	109"	7"
16	16	59	1"	93"	1'	18"	7'	19.5'	6"	73"	12.5"
16	16	81	1"	101"	1'	18"	7'	18'	6"	73"	12.5"
16	16	60	1"	97"	1'	18"	7'	24.5'	6"	73"	12.5"
16	16	60	1"	97"	1'	18"	7'	23.5'	6"	73"	12.5"
16	16	81	1"	101"	1'	18"	7'	24'	6"	73"	12.5"
60	54	118	1"	120"	1'	18"	12'	55' *	6"	133"	6"

NOTE:
TYPICAL FOUNDATION FOR REFERENCE ONLY.

LDP Consulting Engineers
LARAMORE, DOUGLASS, & POPHAM
332 SOUTH MICHIGAN AVE
CHICAGO, ILLINOIS 60604

EXCELSIOR ENERGY INC.
11100 WAYZATA BLVD. MINNETONKA, MN 55305

FILE NAME	DATE	REV. DATE
FOUNDATION	10/04/05	
DESCRIPTION		AUTOCAD SCALE
TYPICAL FOUNDATION		

Figure 4.3-2 Pile Foundations for Poorly Drained, Compressible Soils

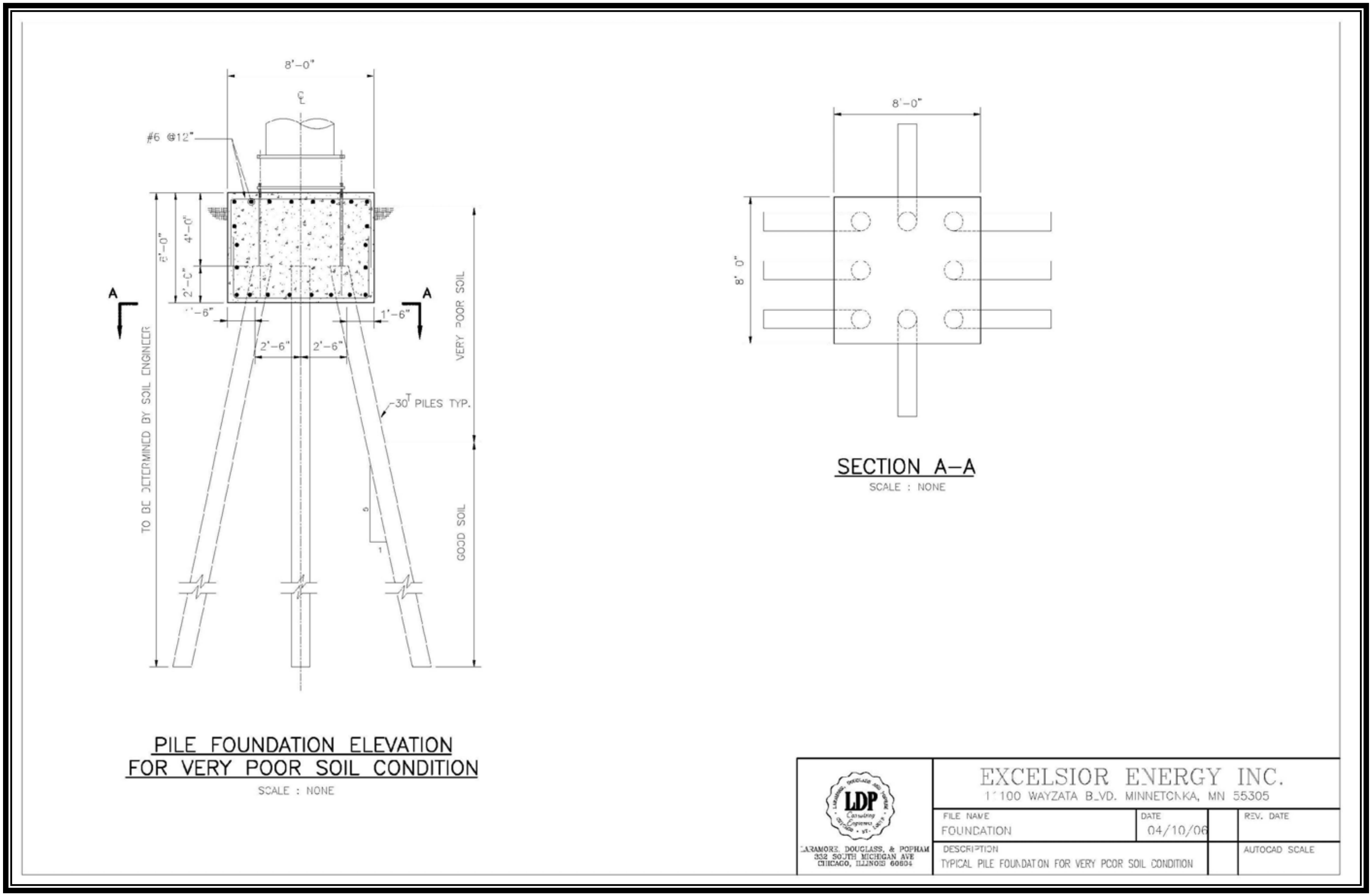


Figure 4.3-3 345kV HVTL Double Circuit Structures Along West Range Plan A Preferred Route (WRA-1)

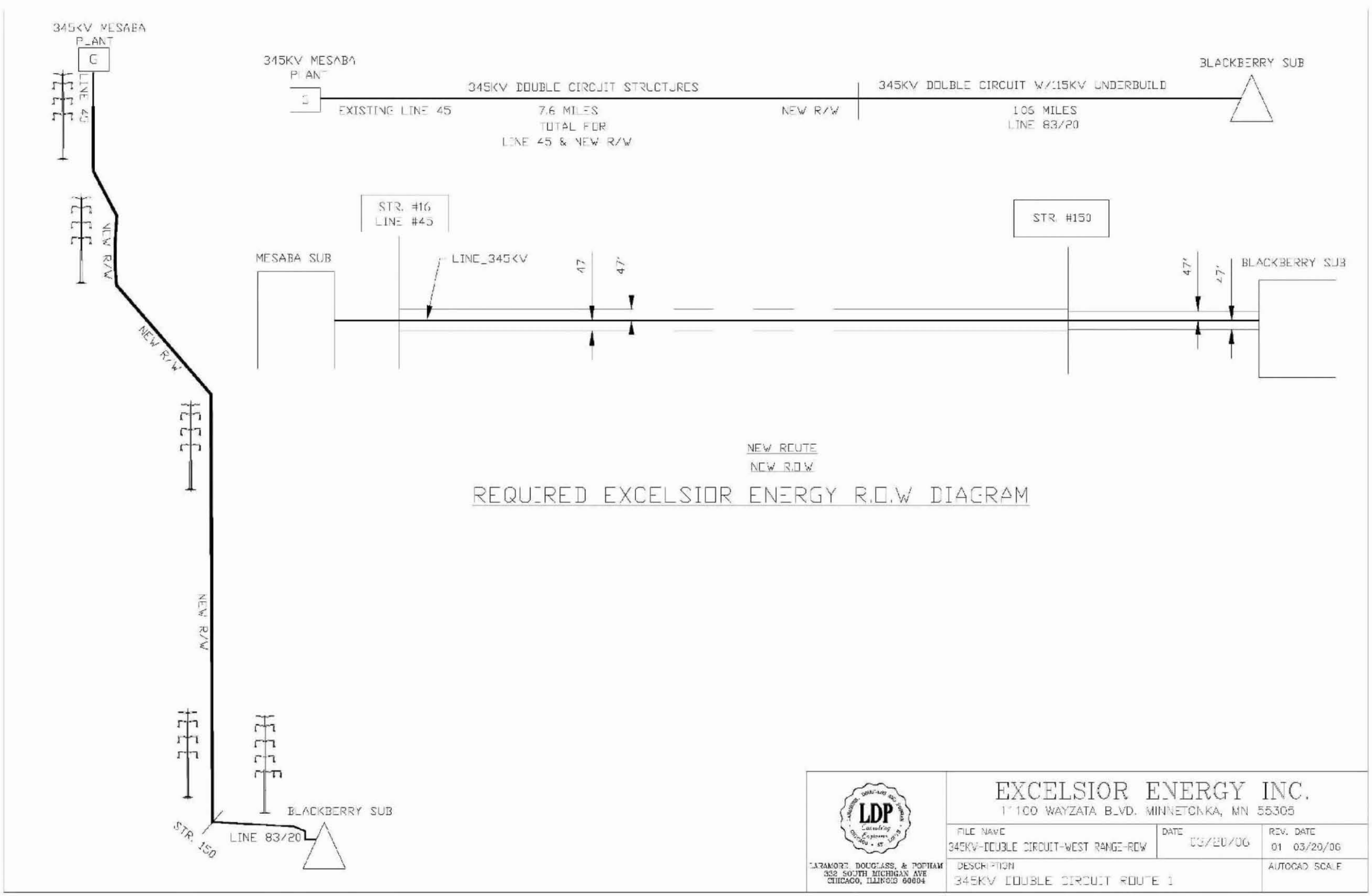


Figure 4.3-4 345kV HVTL Double Circuit Structure Summaryfor West Range Plan A Preffered Route (WRA-1)

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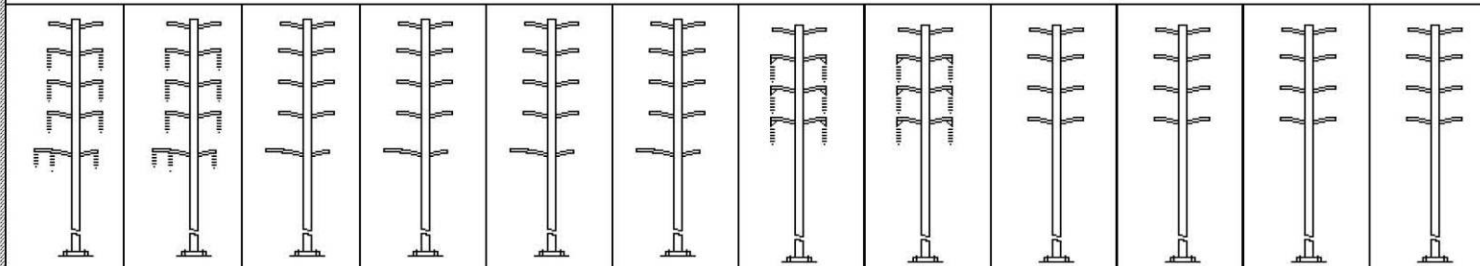
Preliminary Corridor Structure Design for the Diamond Lake Site Route

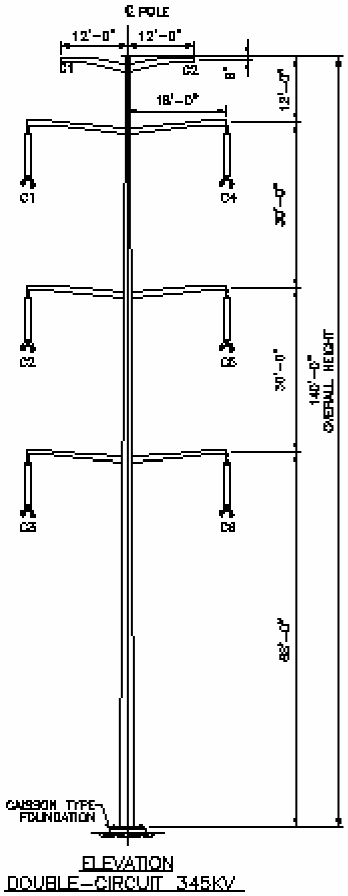
345kV Preliminary Structure Summary



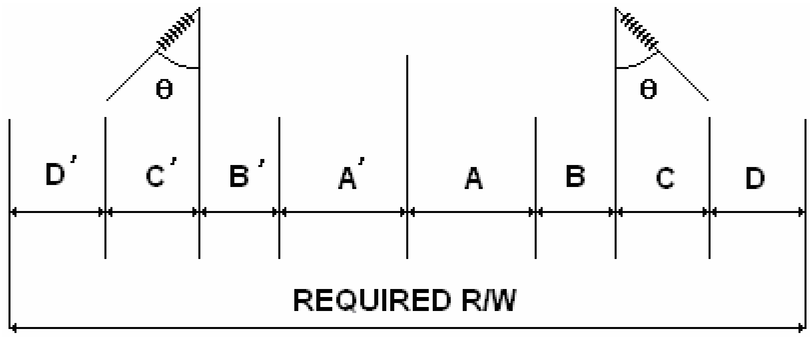
	Structure Type											
Height	SUS1_UB	SUS2_UB	STR1_UB	STR2_UB	DED1_UB	DED2_UB	SUS1	SUS2	STR1	STR2	DED1	DED2
	0°- 2°	2°- 6°	6°- 15°	15°- 30°	30°- 60°	60°- 90°	0°- 2°	2°- 6°	6°- 15°	15°- 30°	30°- 60°	60°- 90°
132										3	6	
140							57					
147				1	0	3						
150							2				0	1
153	6											
168	1											
Total	7	0	0	1	0	3	59	0	0	3	6	1

80 Structures

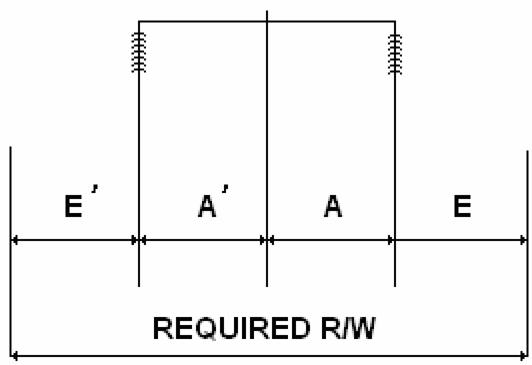
Figure 4.3-5 ROW Calculations for 345kV HVTL Structures Along West Range Plan A Preferred and Alternate Routes (WRA-1 and WRA-1A)



Case 1

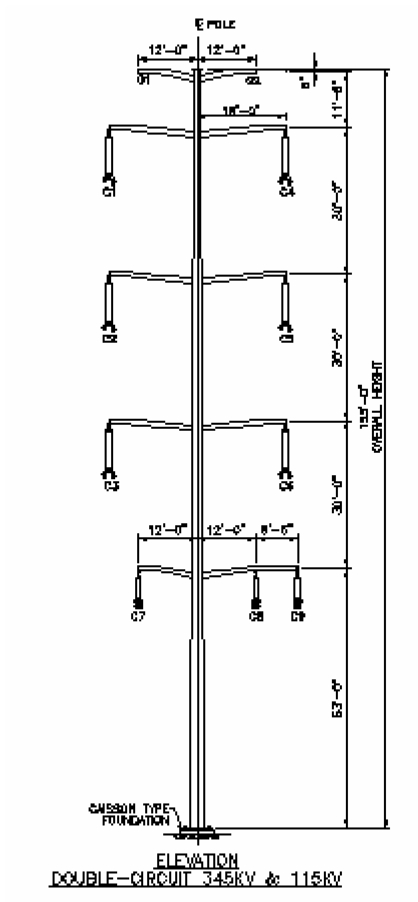


Case 2

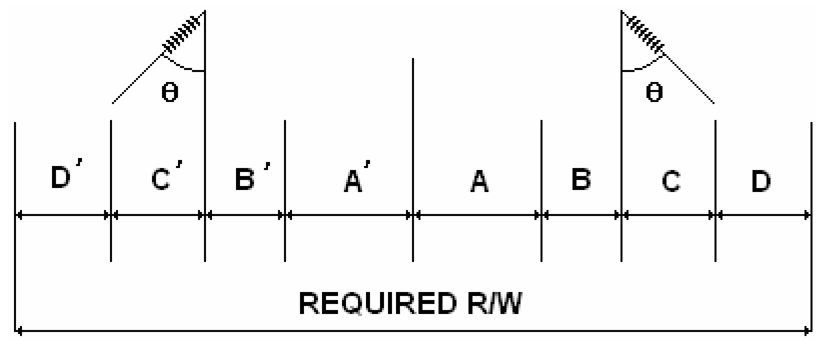


Required Distance (Right side of structure)		Width (ft)
A	Distance between end of arm conductor attachment and center of structure	18
B	Structure attachment deviation due to deflection	5
C	Blowout. Obtained from PLS_CADD 3D model with Twin Pheasant conductor at 6 psf	12
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	10.8
E	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	13.8
	Required ROW (The larger value between Case 1 and Case 2) **A + B + C + D**	**91.6**

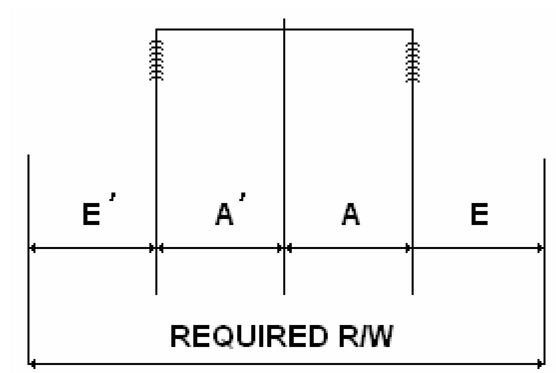
Figure 4.3-6 ROW Calculation for 345kV Double Circuit Structure with 115kV Underbuild Along West Range Plan A Preferred and Alternate Routes (WRA-1 and WRA-1A)



Case 1

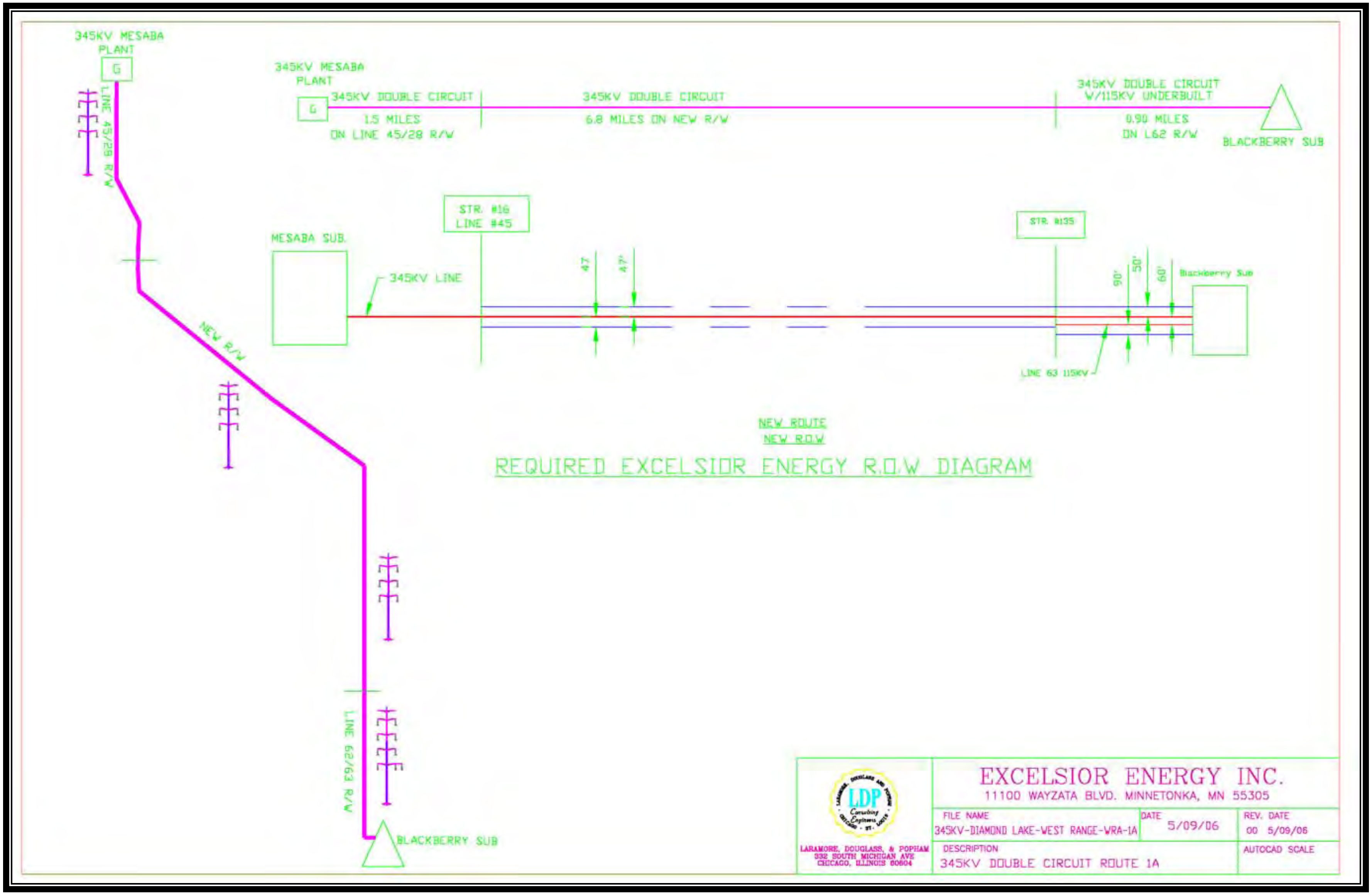


Case 2



Required Distance (Left Side of Structure)		Width (ft)
A'	Distance between end of arm conductor attachment and center of structure (345kV arm)	18
B'	Structure attachment deviation due to deflection	5
C'	Blowout. Obtained from PLS_CADD 3D model with Twin Pheasant conductor at 6 psf	12
D'	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	10.8
E'	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	13.8
	Required ROW (The larger value between Case 1 and Case 2). **A' + B' + C' + D'**	**91.6**

Figure 4.3-7 345kV HVTL Double Circuit Structures Along West Range Plan A Alternate Route (WRA-1A)



4.3.1.2 Plan B

4.3.1.2.1 Preferred Routes: Phase I and II

The Applicant's preferred option for Plan B involves the combination of the two shortest, most direct routes between the IGCC Power Station and its POI. This combination includes the preferred Route WRB-1 for Phase I and the preferred route WRB-2 for Phase II. The routing schematic showing the HVTL structures used along the line segments is shown in Figure 4.3-8. Structure summaries for the double circuit 230kV and single circuit delta 230kV structures are provided in Figure 4.3-9. The layout and required width of the ROW along the line segment within which the double circuit and single circuit 230kV HVTLs traverse the same corridor is illustrated in Figure 4.3-10. The width of ROW and the methodology used in calculating it for each of the structure types are provided in Figures 4.3-11, 4.3-12, 4.3-13 and 4.3-14 for the 230kV double circuit, the 230kV double circuit with 115kV underbuild, and the 230kV single circuit HVTL, and 230 kV single circuit with underbuild, respectively.

4.3.1.2.2 Alternate Routes: Phase I and II

Table 4.2-2 above identifies two alternatives (Option 2 and Option 3) to the Plan B preferred option described in the preceding section. Figures 2.2-3 and 2.2-4 provide the routing schematics generally indicative of Option 2 and Option 3. The structure summary for the first phase will be identical configuration to that shown in Figure 4.3-9 for the preferred combination route identified in Section 4.3.1.2.1 above. The 230kV double circuit structure types used have been shown in Figures 4.3-11 and 4.3-12. The structure summary for the alternate 345kV HVTL Route WRB-2A that would traverse the existing 28L and 62L/63L corridors is shown in Figure 4.3-16. The ROW calculations for the single circuit 345kV with 115kV underbuild single pole structures are shown in Figure 4.3-17 (for spans of 750 feet or shorter) and Figures 4.3-18a and 4.3-18b (for spans up to 1,100 feet). The ROW calculations for the single circuit 345kV delta configuration structures are presented in Figure 4.3-25.

1.1.1.1 "H" Frame Structures

The Applicant may opt to use "H" frame structures for stretches of the HVTL that traverse its property and/or where aesthetic concerns demand use of shorter, less visible structures. The dimensions and basis for the ROW calculations for 230kV and 345kV "H" frame structures are presented in Figures 4.3-19 and 4.3-20, respectively.

Figure 4.3-8 230kV HVTL Double Circuit Structures Along West Range Plan B Phase I and II Preferred Routes (WRB-1 + WRB-2) See Table 4.2-2 for Option 1

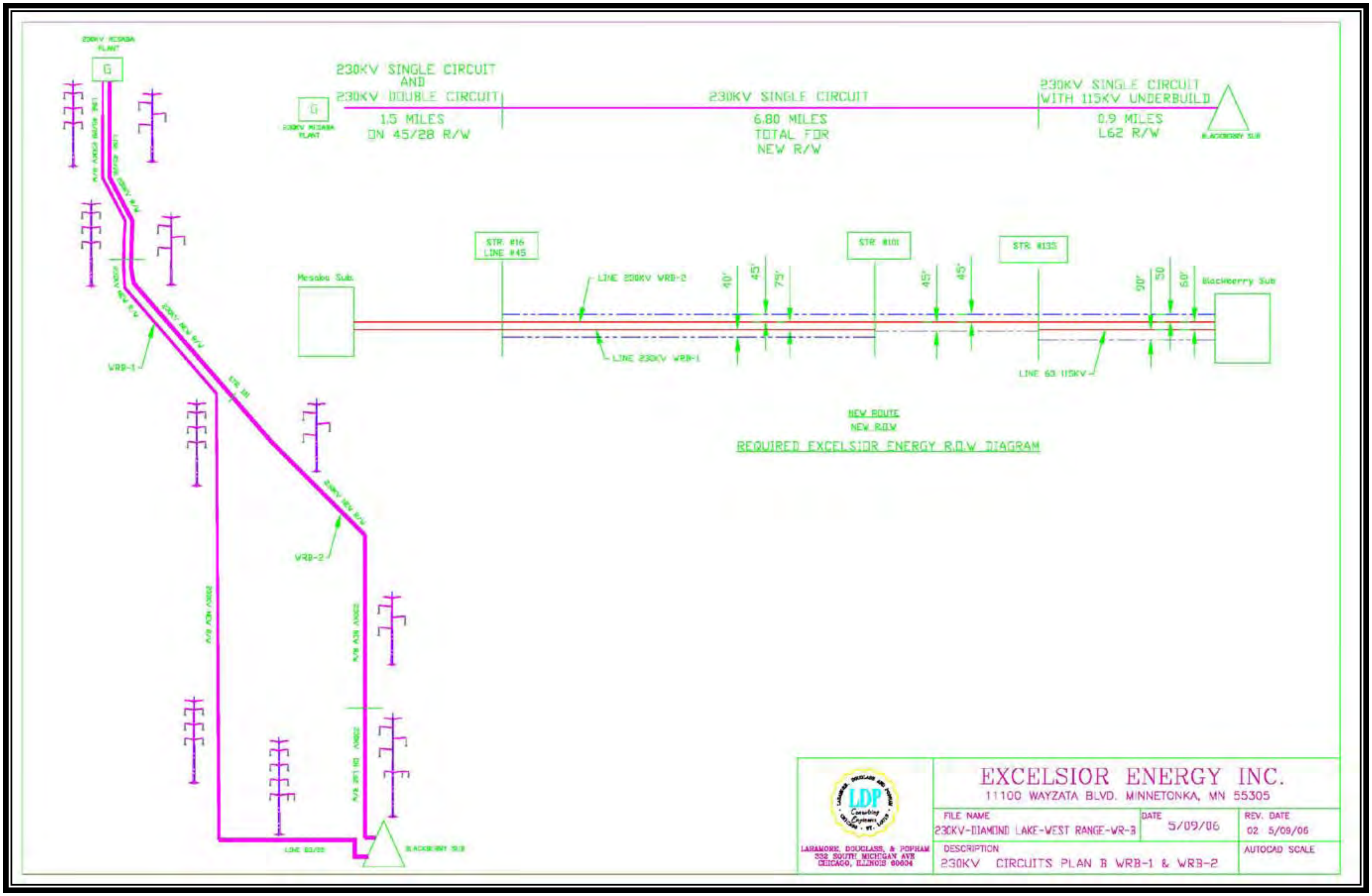


Figure 4.3-9 Plan B Phase I Preferred Route WRB-1 230kV Double Circuit HVTL Structure Summary

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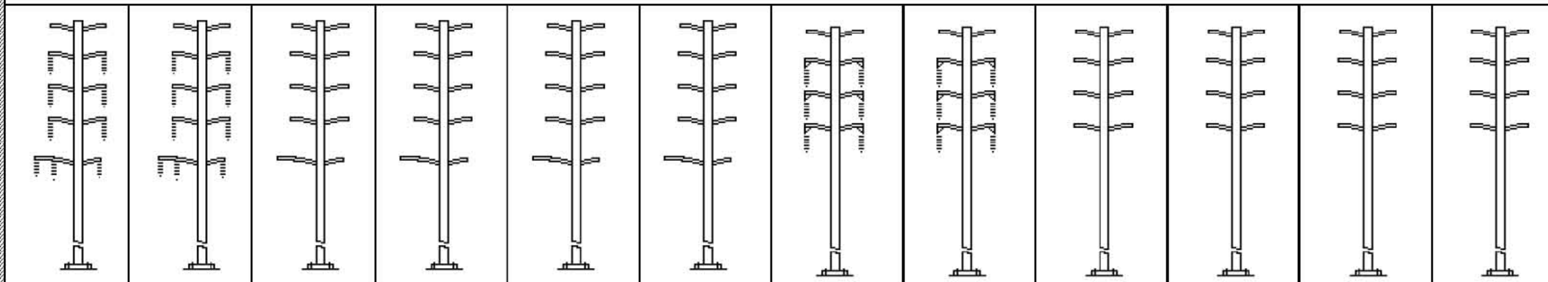
Preliminary Corridor Structure Design for the West Range Site: Alternative 1 Route, Phase I

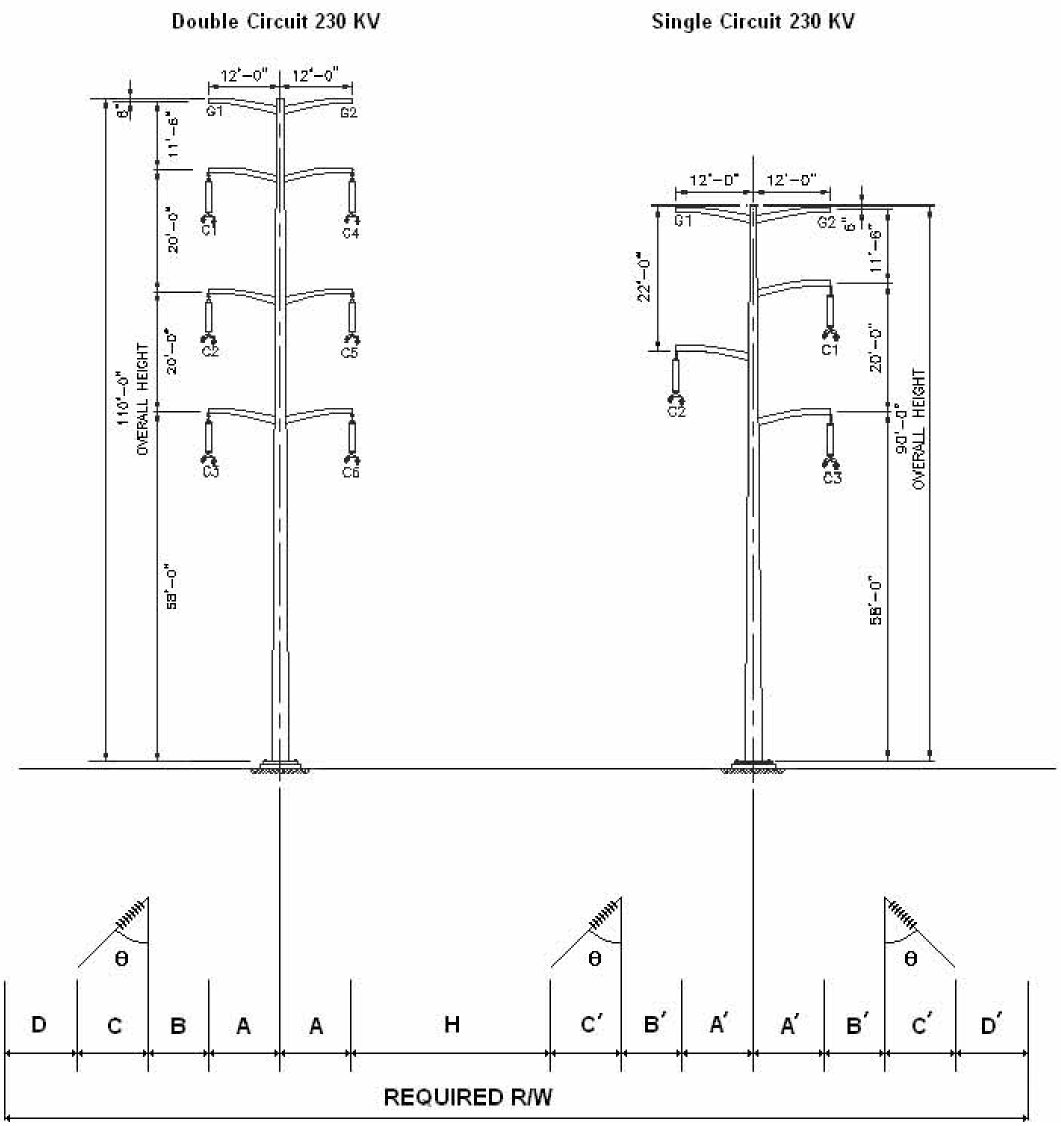
230kV Preliminary Structure Summary



Height	Structure Type											
	SUS1_UB	SUS2_UB	STR1_UB	STR2_UB	DED1_UB	DED2_UB	SUS1	SUS2	STR1	STR2	DED1	DED2
	0°- 2°	2°- 6°	6°- 15°	15°- 30°	30°- 60°	60°- 90°	0°- 2°	2°- 6°	6°- 15°	15°- 30°	30°- 60°	60°- 90°
107										3	6	
115							57					
122				1	0	3						
125							2				0	1
128	6											
143	1											
Total	7	0	0	1	0	3	59	0	0	3	6	1

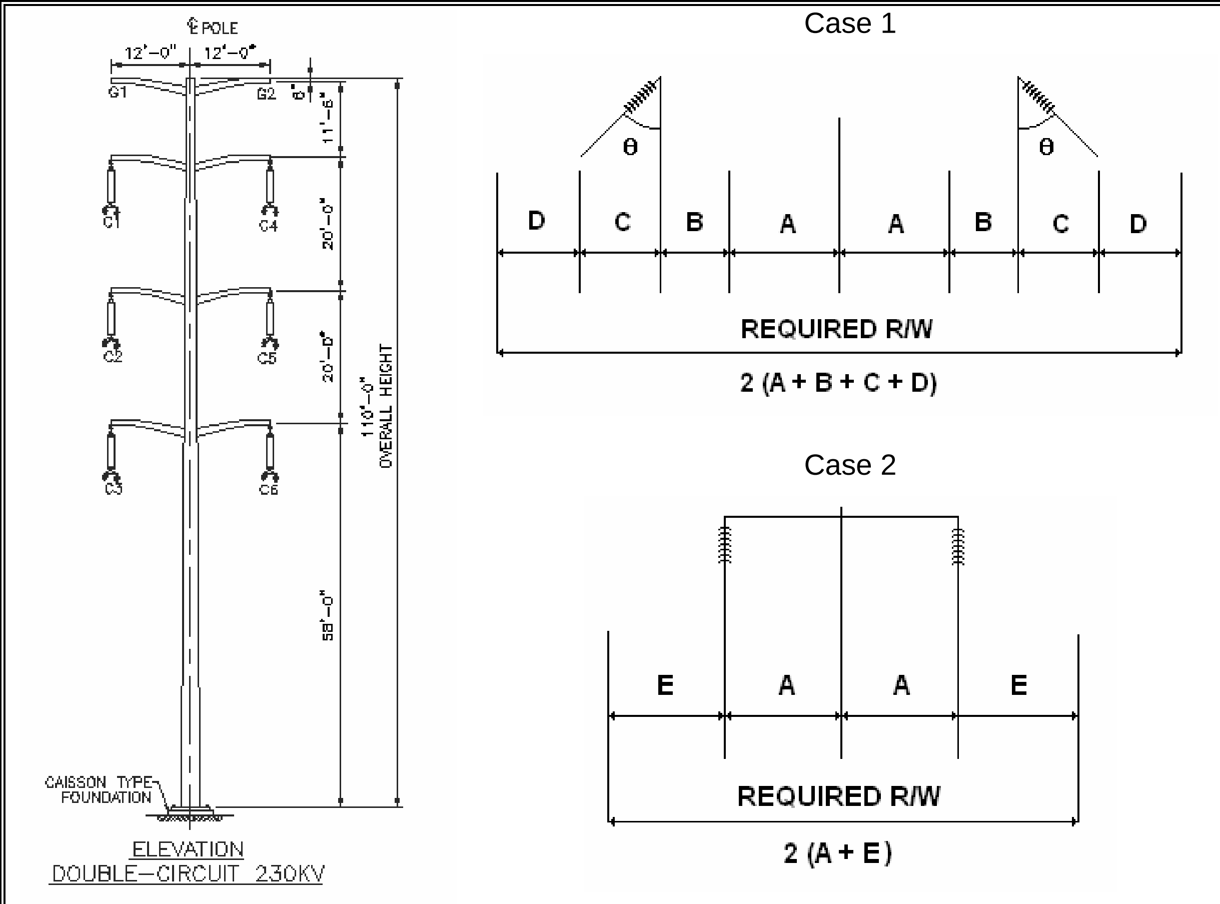
80 Structures

Figure 4.3-10 ROW Calculations for 230kV Double Circuit and 230kV Single Circuit HVTL



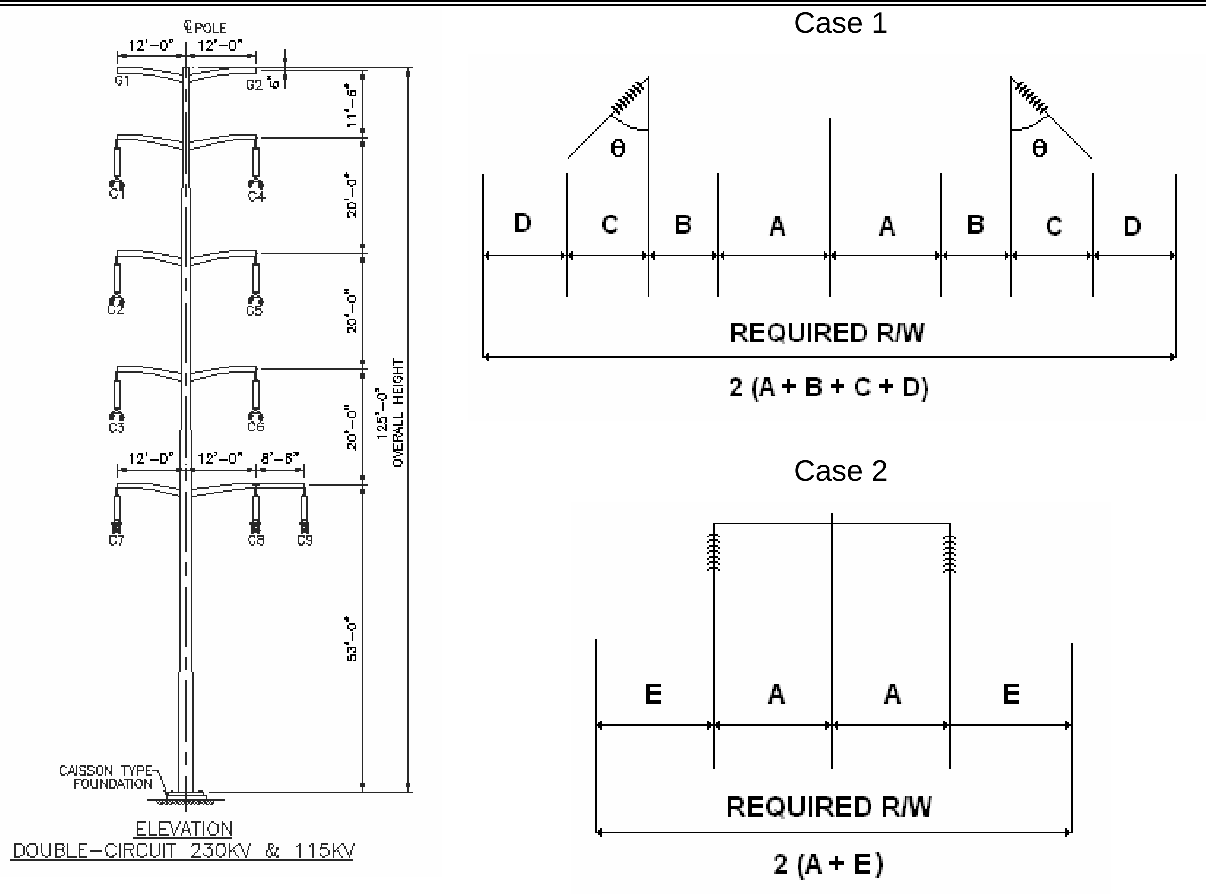
	Required Distance	Width (ft)
A	Distance between end of arm conductor attachment and center of structure	12
B	Structure attachment deviation due to deflection	4
C	Blowout. Obtained from PLS_CADD 3D model with Twin Pheasant conductor at 6 psf	12
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	8.25
H	Minimum horizontal working distance between arms to provide safe construction and maintenance between parallel lines	25
A'	Distance between end of arm conductor attachment and center of structure	12
B'	Structure attachment deviation due to deflection	4
C'	Blowout. Obtained from PLS_CADD 3D model with Twin Pheasant conductor at 6 psf	12
D'	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	8.25
	ROW = 2A + B + C + D + H + 2 (A' + B' + C') + D'	**137.50**

Figure 4.3-11 ROW Calculation for 230kV Double Circuit HVTL



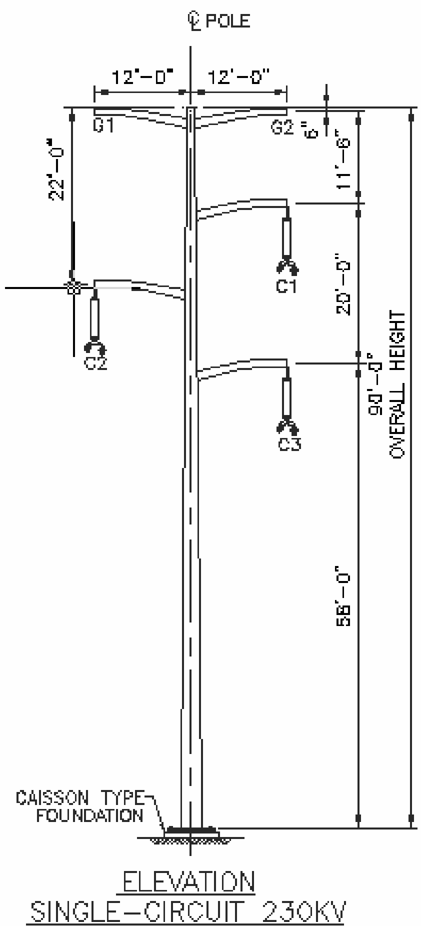
	Required Distance	Width (ft)
A	Distance between end of arm conductor attachment and center of structure	12
B	Structure attachment deviation due to deflection	4
C	Blowout. Obtained from PLS_CADD 3D model with Twin Cardinal conductor at 6 psf	12
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	8.25
E	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	11
	Required Right of Way (The larger value between Case 1 and Case 2)	**72.5**

Figure 4.3-12 ROW Calculation for 230kV Double Circuit HVTL with 115kV Underbuild

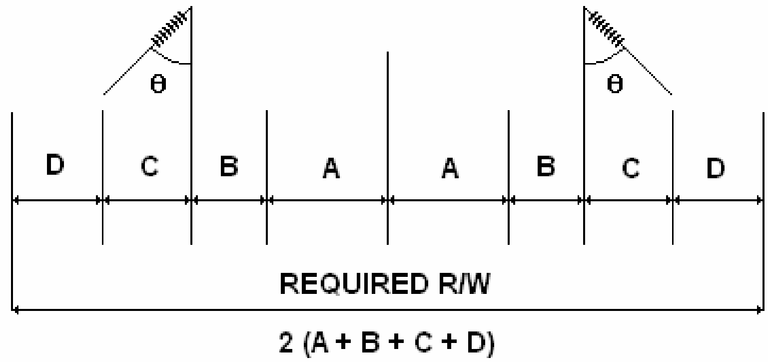


	Required Distance	Width (ft)
A	Distance between end of arm conductor attachment and center of structure	20.5
B	Structure attachment deviation due to deflection	4
C	Blowout. Obtained from PLS_CADD 3D model with Grosbeak (636 MCM) conductor at 6 psf for 115 Circuit	12
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	6.6
E	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	9.6
	Required ROW (The larger value between Case 1 and Case 2)	**86.2**

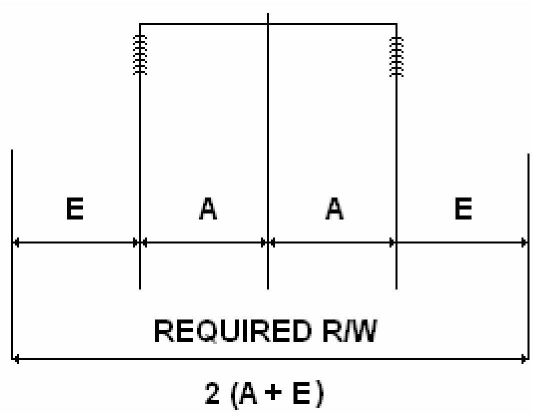
Figure 4.3-13 ROW Calculation for 230kV Single Circuit HVTL



Case 1



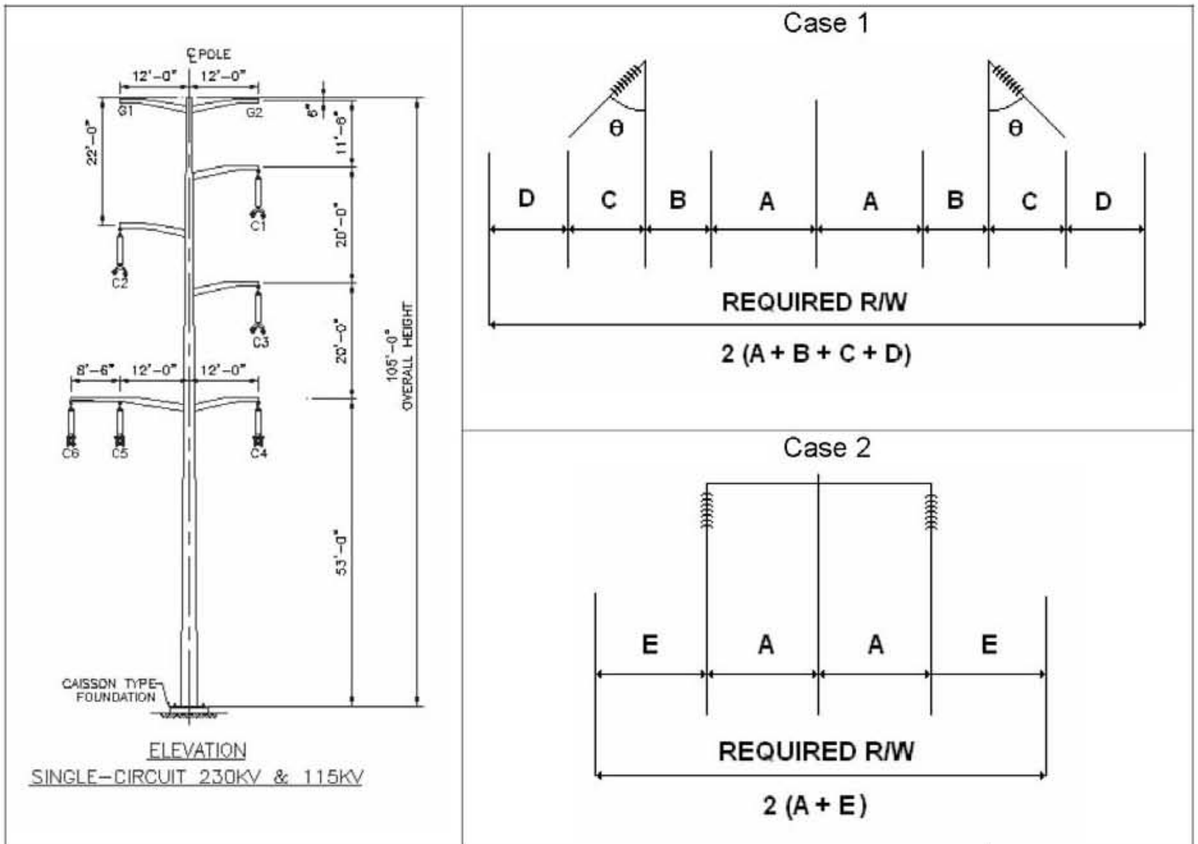
Case 2



Required Distance		Width (ft)
A	Distance between end of arm conductor attachment and center of structure	12
B	Structure attachment deviation due to deflection	4
C	Blowout. Obtained from PLS_CADD 3D model with Twin Cardinal conductor at 6 psf	12
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	8.25
E	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	11
	Required Right of Way (The larger value between Case 1 and Case 2)	**72.5**

Figure 4.3-14 ROW Calculation for 230kV Single Circuit HVTL with Underbuild

Right of Way (ROW) for 230 KV - 1 CKT with 115 KV



	Required Distance	Width (ft)
A	Distance between end of arm conductor attachment and center of structure	20.5
B	Structure attachment deviation due to deflection	4
C	Blowout. Obtained from PLS_CADD 3D model with Grosbeak (636 MCM) conductor at 6 psf for 115 Circuit	12
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	6.6
E	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	9.6
	Required ROW (The larger value between Case 1 and Case 2)	**86.2**

Figure 4.3-15 345kV HVTL Single Circuit Delta Configuration Structures With 115kV Underbuild Along West Range Plan B Phase II Alternate Route (WRB-2A) See Table 4.2-2 for Option 2

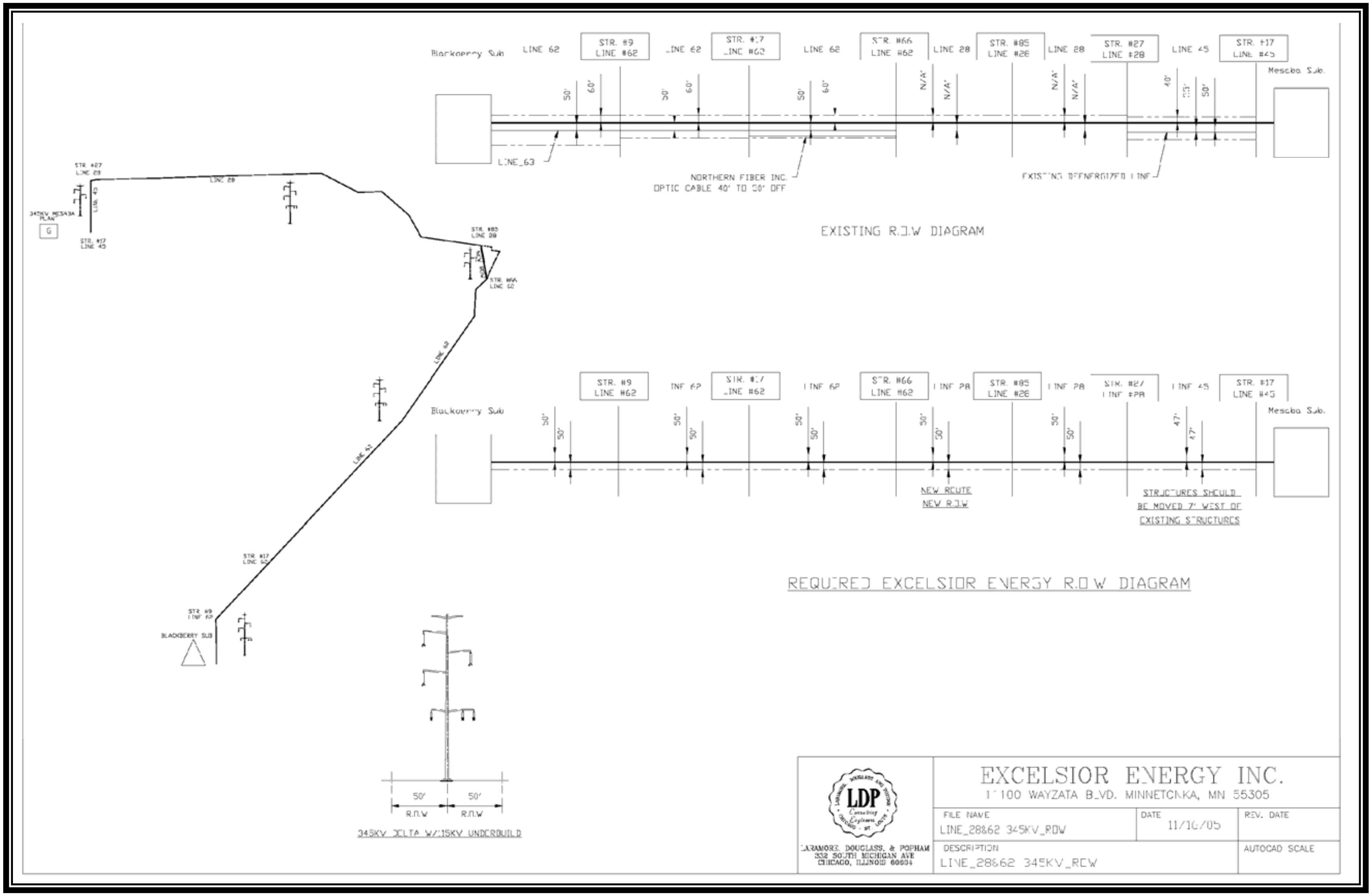


Figure 4.3-16 Plan B Phase II Alternate Route WRB-2A 345kV Double Circuit HVTL Structure Summary

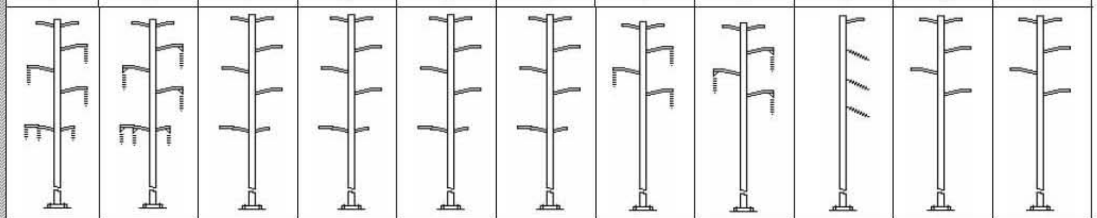
	Structure Type										
	1	2	3	4	5	6	7	8	9	10	11
											
Height	SUS1_UB	SUS2_UB	STR1_UB	STR2_UB	DED1_UB	DED2_UB	SUS1	SUS2	RAN1	DED1	DED2
	0° - 2°	2°-6°	6°-15°	15°-30°	30°-60°	60°-90°	0° - 2°	2°-15°	15°-30°	30°-60°	60°-90°
107	1										1
108.5							1				
110.0							8				
113.0	1										
117.5	77						8				
119.0							1				
120.0			1								
122.0	18						1				
124.0					2	1					
124.5				3							
126.0			1								
126.5	11						1				
128.5											1
129.0					2						
131.0	1										
133.0											1
133.5					1						
135.5											
137.0									1		
137.5						1					
140.0	1										
144.5											
149.0											
Total	110	0	2	3	5	2	20	0	1	0	3

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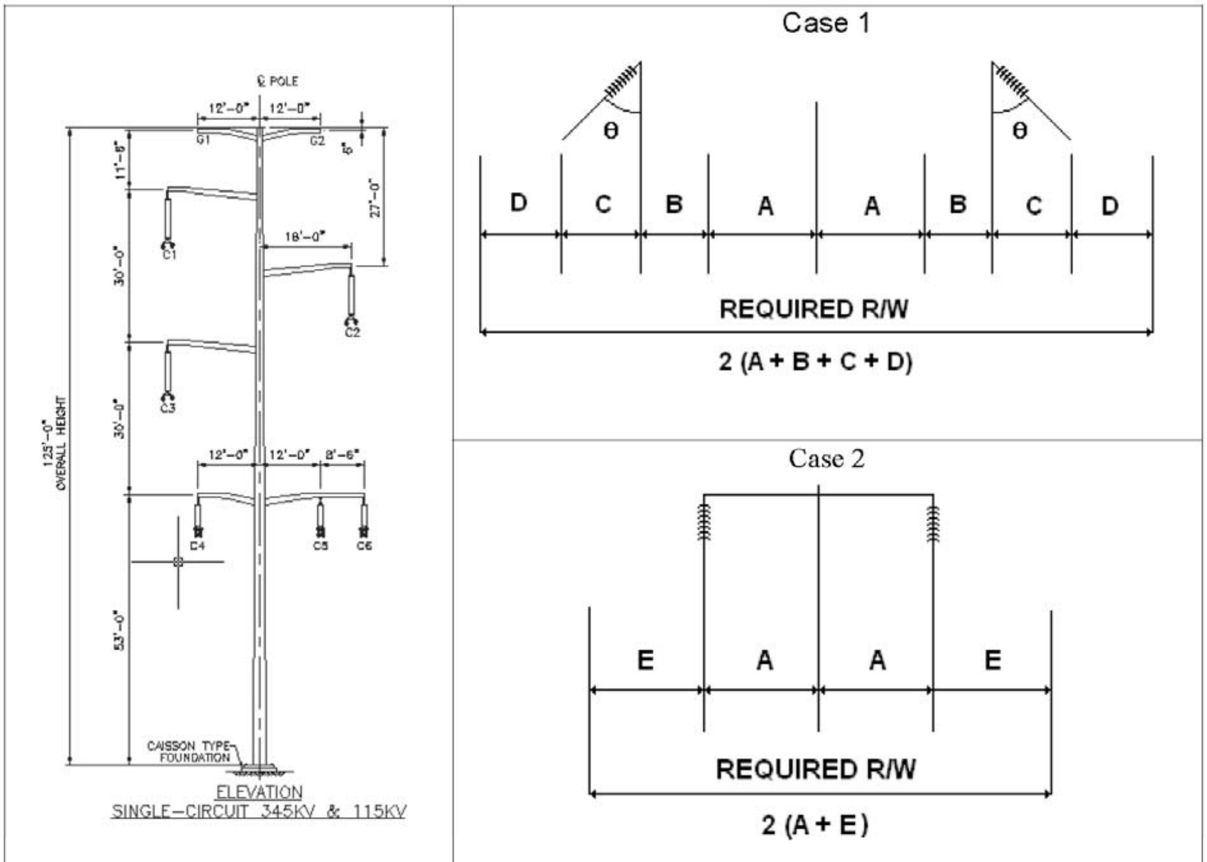
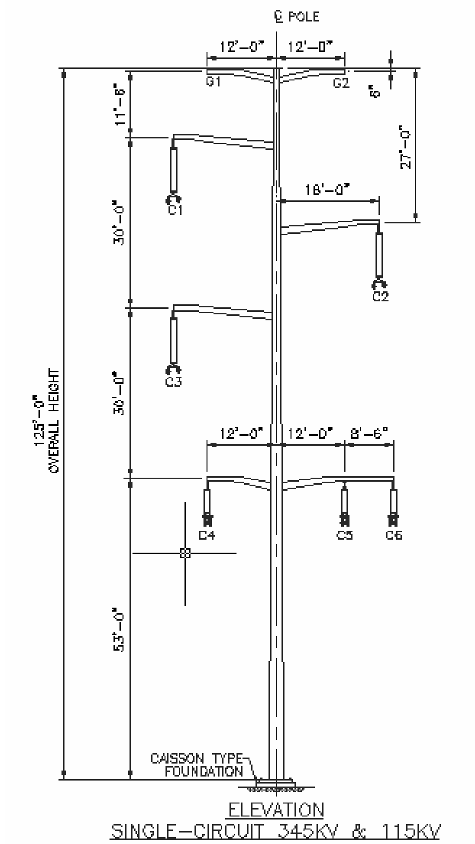
Figure 4.3-17 ROW Calculation for 345 kV Single Circuit Delta Configuration With 115 kV Underbuild (750 ft Span)

Right of Way (ROW) for 345 KV - 1 CKT with 115 KV

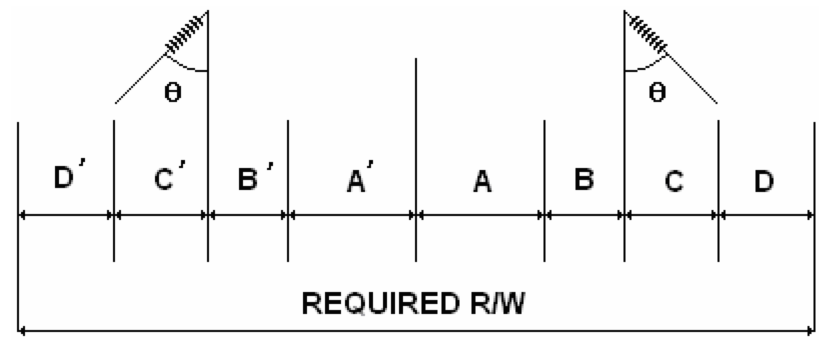


Required Distance		Width (ft)
A	Distance between end of arm conductor attachment and center of structure	20.5
B	Structure attachment deviation due to deflection	5
C	Blowout. Obtained from PLS_CADD 3D model with Grosbeak (636 MCM) conductor at 6 psf for 115 KV circuit.	12
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	6.6
E	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	9.6
	Required ROW (The larger value between Case 1 and Case 2)	**88.2**

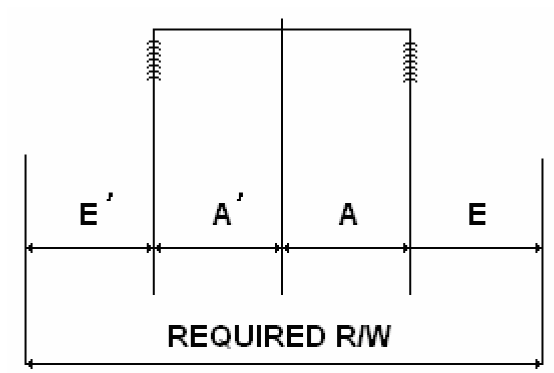
Figure 4.3-18a ROW Calculation for 345 kV Single Circuit Delta Configuration With 115 kV Underbuild (1100 ft Span Right Side)



Case 1

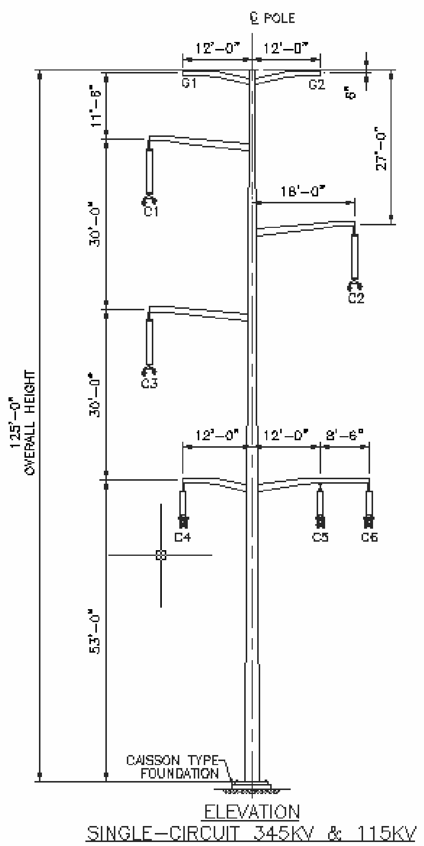


Case 2

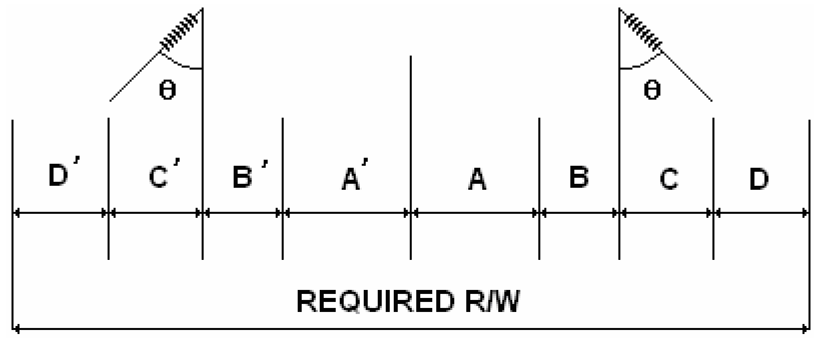


Required Distance (Right side of structure)		Width (ft)
A	Distance between end of arm conductor attachment and center of structure (115kV lower arm)	20.5
B	Structure attachment deviation due to deflection	5
C	Blowout. Obtained from PLS_CADD 3D model with Grosbeak (636 MCM) conductor at 6 psf for 115kV circuit.	20.3
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	6.6
E	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	9.6
	Required ROW (The larger value between Case 1 and Case 2) **A + B + C + D**	**52.4**

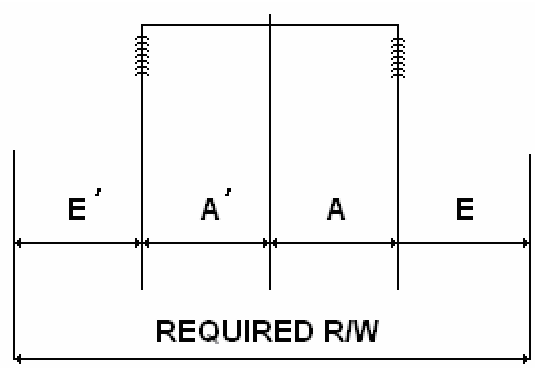
Figure 4.3-18b ROW Calculation for 345kV Single Circuit Delta Configuration With 115kV Underbuild (1100 ft Span Left Side)



Case 1



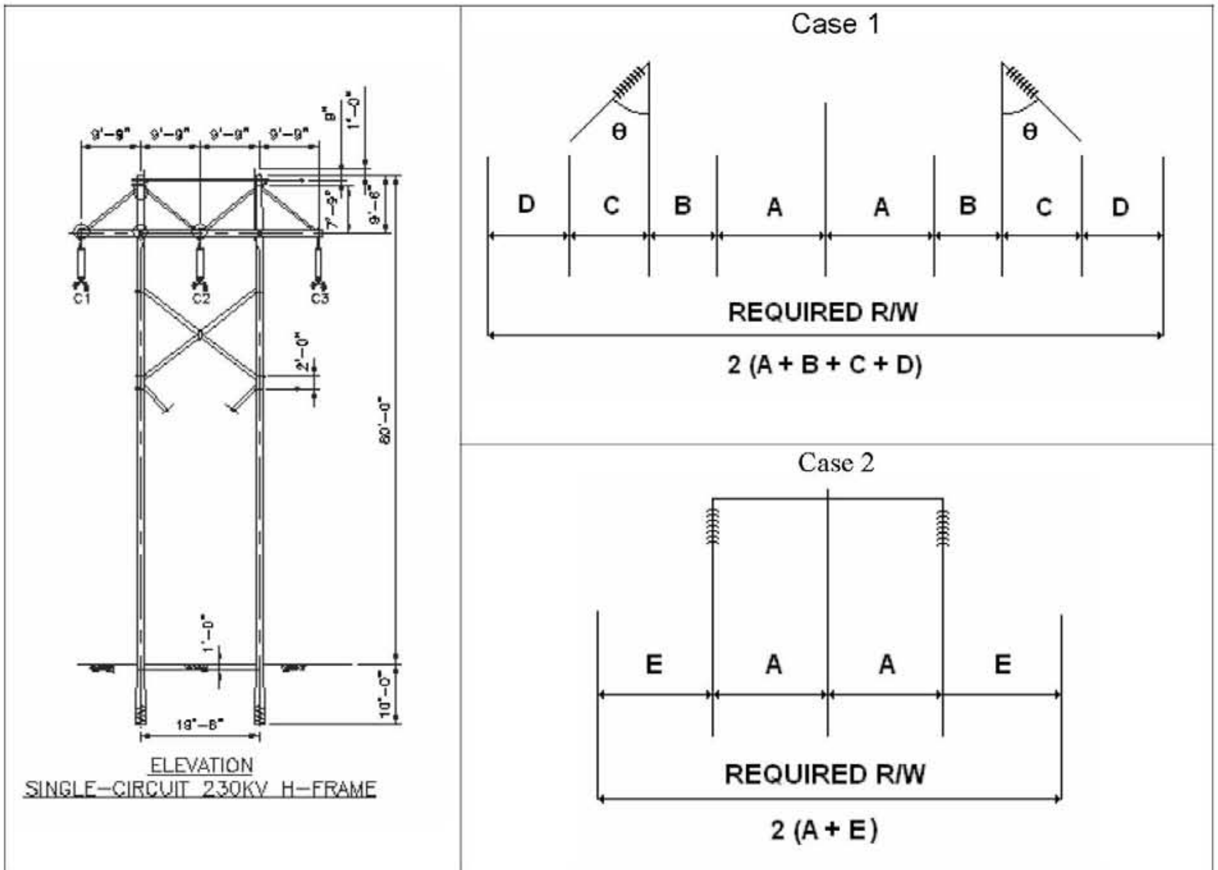
Case 2



Required Distance (Left Side of Structure)		Width (ft)
A'	Distance between end of arm conductor attachment and center of structure (345 KV)	18
B'	Structure attachment deviation due to deflection	6
C'	Blowout. Obtained from PLS_CADD 3D model with Twin Pheasant conductor at 6 psf	18.7
D'	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	10.8
E'	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	13.8
	Required ROW (The larger value between Case 1 and Case 2). **A' + B' + C' + D'**	**53.5**
Total ROW	**52.4 + 53.5**	**105.9**

Figure 4.3-19 ROW Calculations for 230kV "H" Frame Structures for Special Uses

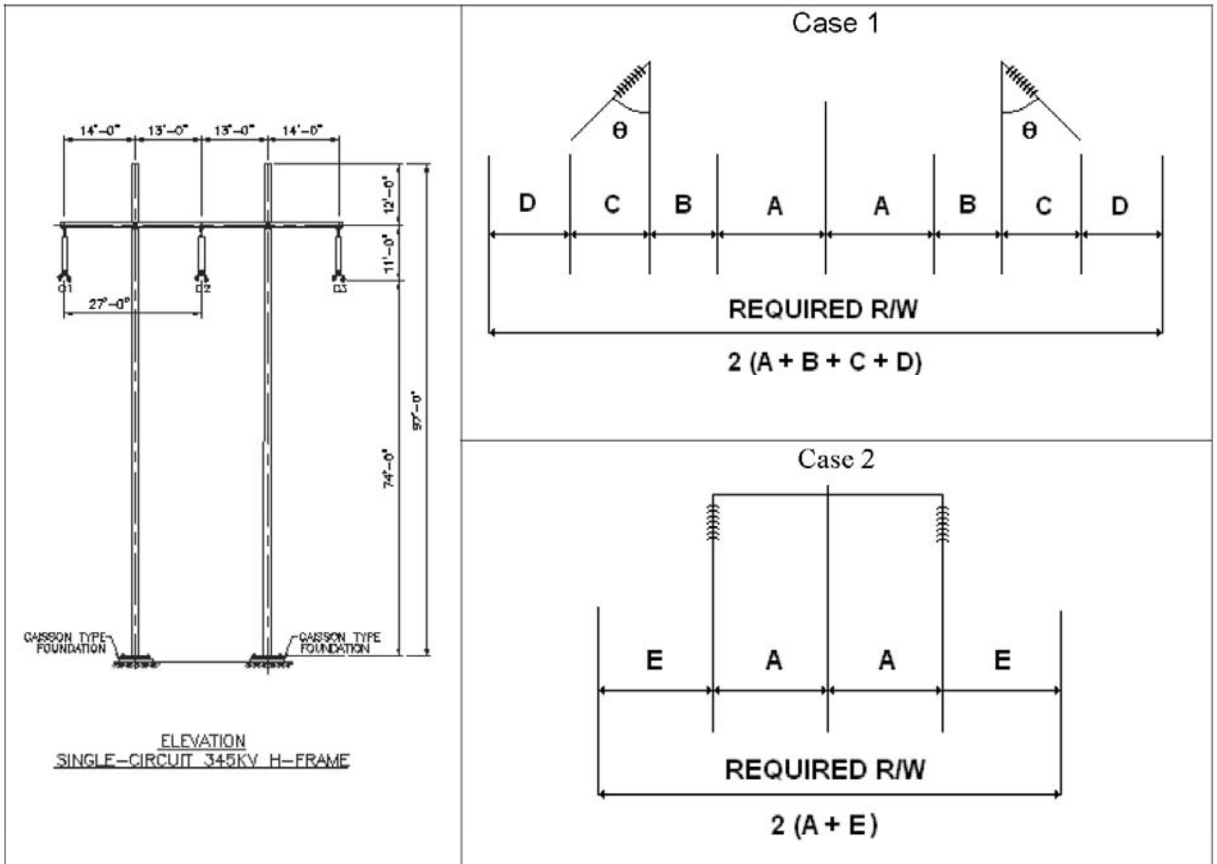
Right of Way (ROW) for 230 KV - H-FRAME



	Required Distance	Width (ft)
A	Distance between end of arm conductor attachment and center of structure	17.5
B	Structure attachment deviation due to deflection	3
C	Blowout. Obtained from PLS_CADD 3D model with Grosbeak conductor at 6 psf	12
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	6.6
E	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	9.6
	Required ROW (The larger value between Case 1 and Case 2)	**78.2**

Figure 4.3-20 ROW Calculations for 345kV "H" Frame Structure for Special Uses

Right of Way (ROW) for 345 KV - H-FRAME



Required Distance		Width (ft)
A	Distance between end of arm conductor attachment and center of structure	26
B	Structure attachment deviation due to deflection	3
C	Blowout. Obtained from PLS_CADD 3D model with Grosbeak conductor at 6 psf for 115 KV circuit.	12
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	10.8
E	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	13.8
	Required ROW (The larger value between Case 1 and Case 2)	**103.6**

1.1.1.2 East Range

4.3.1.2.3 39L/37L Route: Preferred Configuration

Figure 4.3-21 shows the 345kV/115kV double circuit preferred 39L/37L Route line segments. A preliminary summary of the HVTL structure configurations and heights that would be used along the 345kV preferred 39L/37L Route are provided in Figure 4.3-22. A detailed analysis showing the ROW required for each of the structures is provided in Figure 4.3-23a and Figure 4.3-23b (the double circuit 345kV/115kV structure sufficient to span 750 feet); Figure 4.3-24a and Figure 4.3-24b show the double circuit 345kV/115kV structure sufficient to span 1,100 feet. The ROW calculations for the single circuit delta configuration 345kV structure are shown in Figure 4.3-25.

4.3.1.2.4 38L Route: Preferred Configuration

Figure 4.3-26 shows the 345kV single circuit (with 115kV underbuild) 38L Route line segments. The HVTL structures used in this route were shown previously in Figures 4.3-17, 4.3-18a, 4.3-18b, and 4.3-25. This route will not require additional ROW. The preliminary structure summarizes for the 38L route are provided in Figure 4.3-27.

4.3.1.2.5 Alternate Configuration

The alternate configuration would involve reversing the route from which the additional 30 feet of ROW is acquired. That is, the 30 feet of additional ROW would be taken from the 38L Route instead of the 39L/37L route.

Figure 4.3-21 East Range Preferred 39L/37L 345kV HVTL Route and Structure Configurations

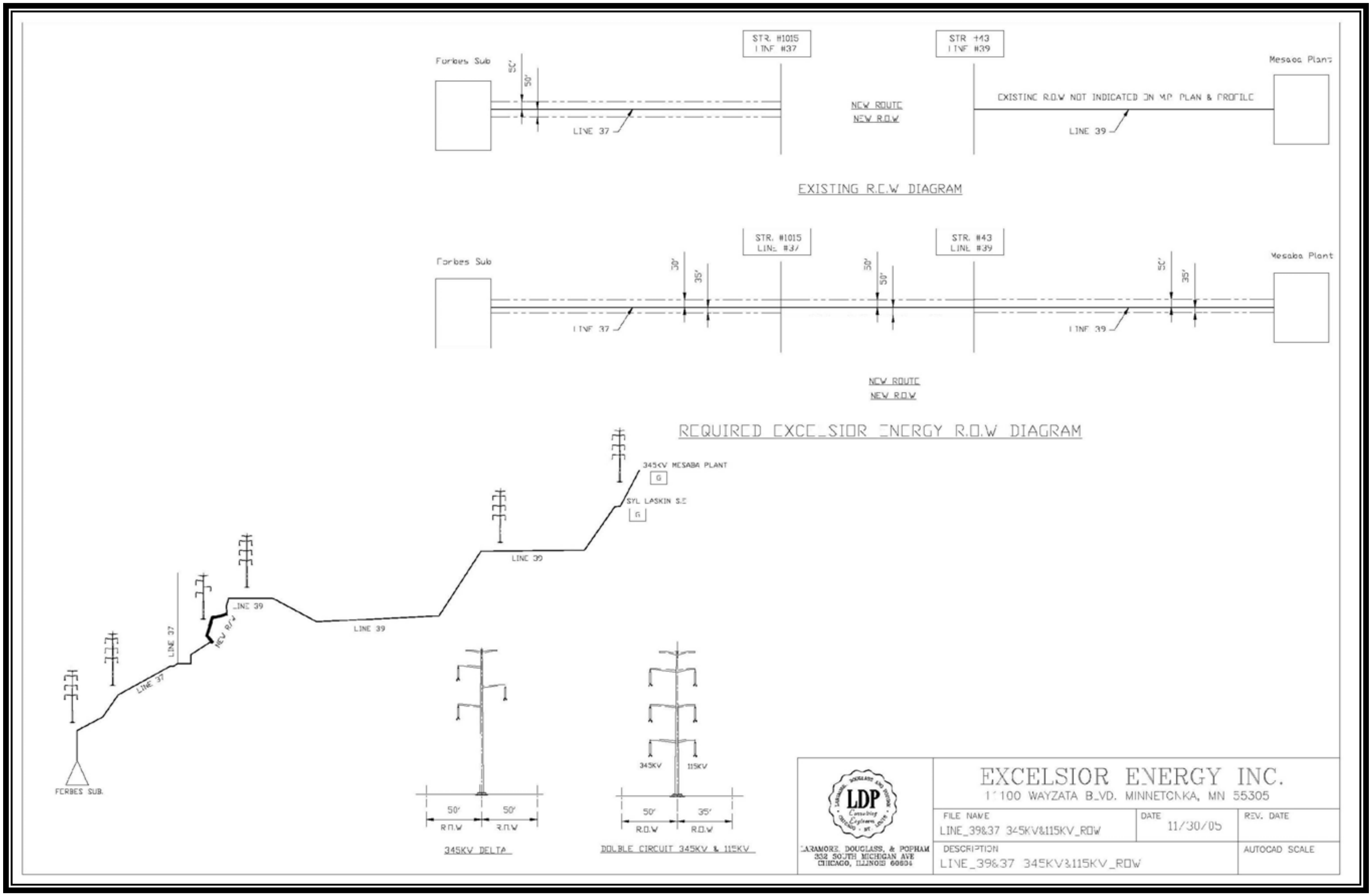
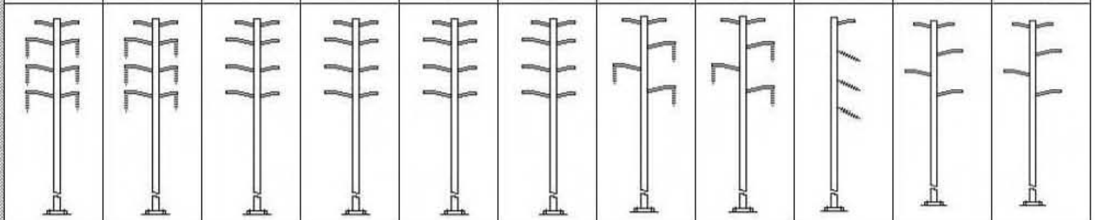


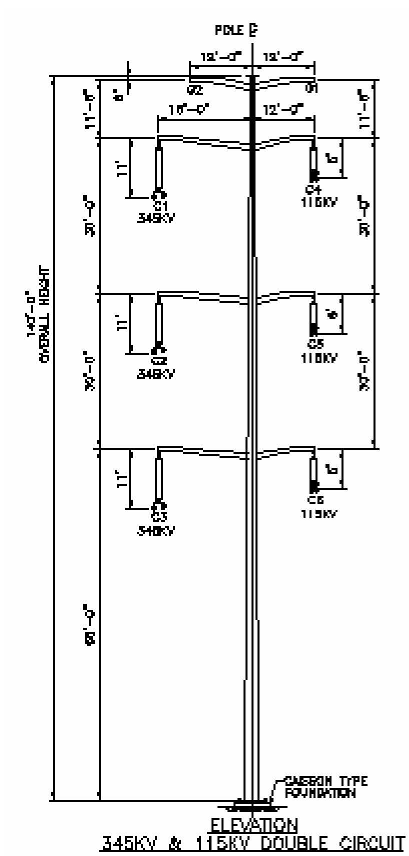
Figure 4.3-22 East Range 39L/37L Leg HVTL Structure Summary



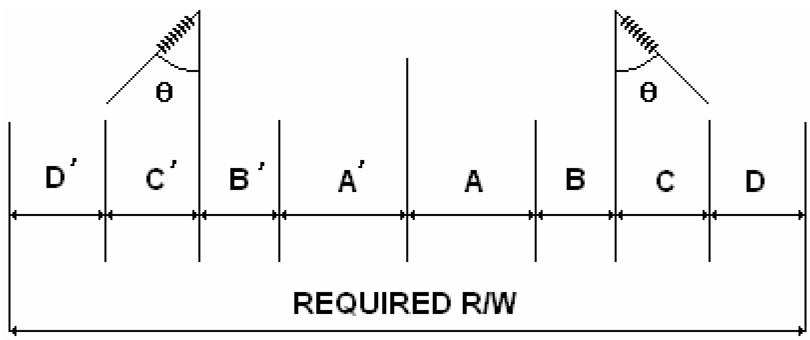
	1	2	3	4	5	6	7	8	9	10	10
Height	SUS1	SUS2	STR1	STR2	DED1	DED2	SUS1(DLT)	SUS2(DLT)	RAN1	DED1(DLT)	DED2(DLT)
	0° - 2°	2°-6°	6°-15°	15°-30°	30°-60°	60°-90°	0° - 2°	2°-15°	15°-30°	30°-60°	60°-90°
90								1	2	2	3
100							11		1		
105							1				
120	1									1	
124	139										
128	1		2	1	10						
129	54										
130						1					
132			1	1	7	2					
133	23						1				
134	1										
137	3		2		3	1					
138	16										
139	1										
141						2					
142	5				2						1
147	6				1					1	
151	1										
155							1				
156	1										
Total	252	0	5	2	23	6	14	1	3	4	4

314 Structures

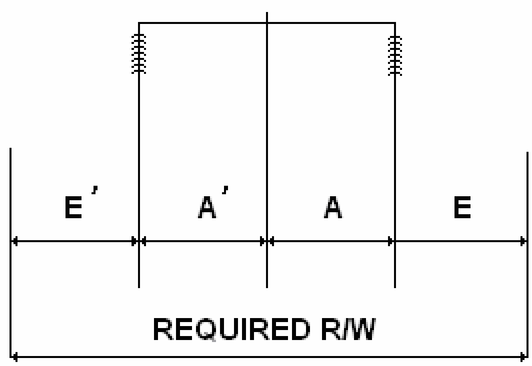
Figure 4.3- 23a East Range 39l/37L Leg HVTL ROW Calculation-345kV/115kV Double Circuit, 750 Foot Span, Right Side Structure



Case 1

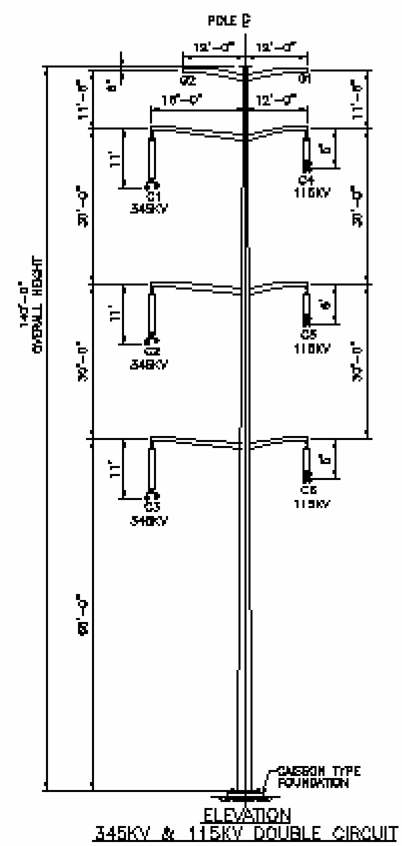


Case 2

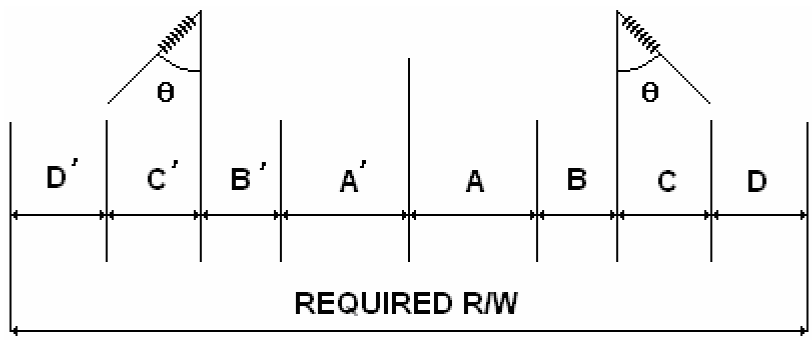


Required Distance (Right side of structure)		Width (ft)
A	Distance between end of arm conductor attachment and center of structure (115kV arm)	12
B	Structure attachment deviation due to deflection	6
C	Blowout. Obtained from PLS_CADD 3D model with Grosbeak (636 MCM) conductor at 6 psf for 115kV circuit.	12
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	6.6
E	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	9.6
	Required ROW (The larger value between Case 1 and Case 2) **A + B + C + D**	**36.6**

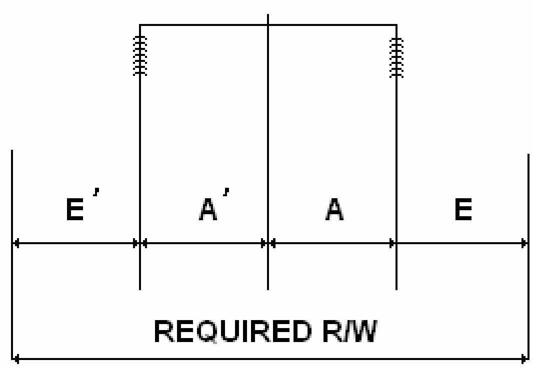
Figure 4.3-23b East Range 39l/37L Leg HVTL ROW Calculation-345kV/115kV Double Circuit, 750 Foot Span, Left Side Structure



Case 1

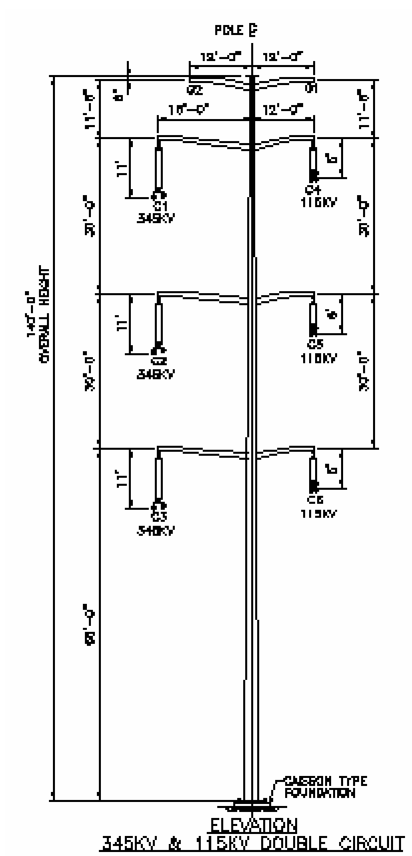


Case 2

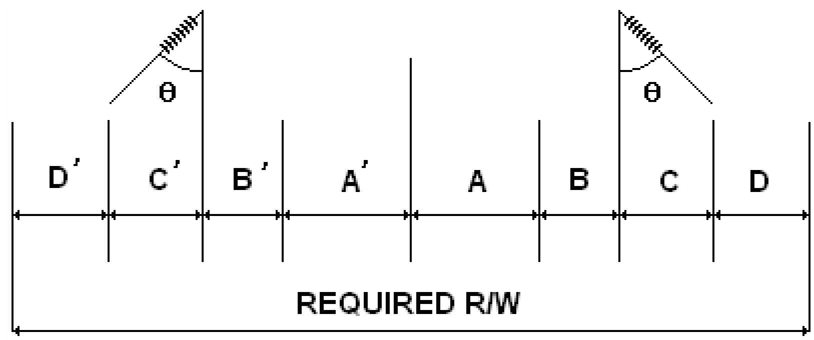


Required Distance (Left Side of Structure)		Width (ft)
A'	Distance between end of arm conductor attachment and center of structure (345kV arm)	18
B'	Structure attachment deviation due to deflection	6
C'	Blowout. Obtained from PLS_CADD 3D model with Twin Pheasant conductor at 6 psf	12
D'	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	10.8
E'	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	13.8
	Required ROW (The larger value between Case 1 and Case 2). **A' + B' + C' + D'**	**46.8**
Total ROW	**36.6 + 46.81**	**83.4**

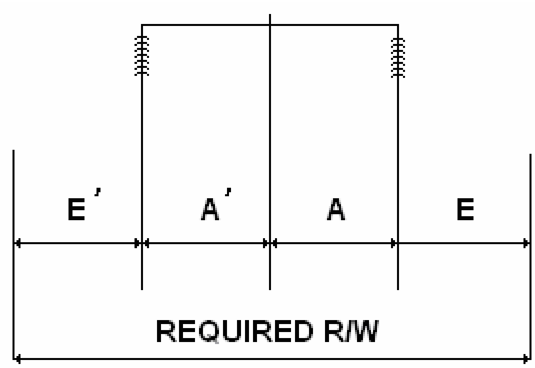
Figure 4.3-24a East Range 39l/37L Leg HVTL ROW Calculation-345kV/115kV Double Circuit, 1100 Foot Span, Right Side Structure



Case 1

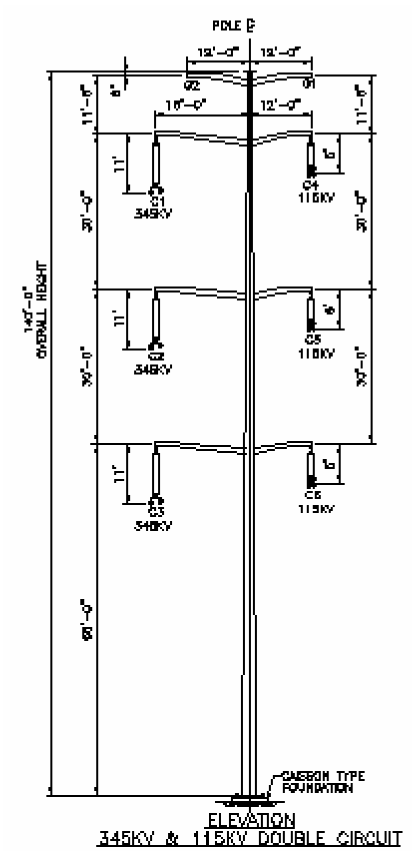


Case 2

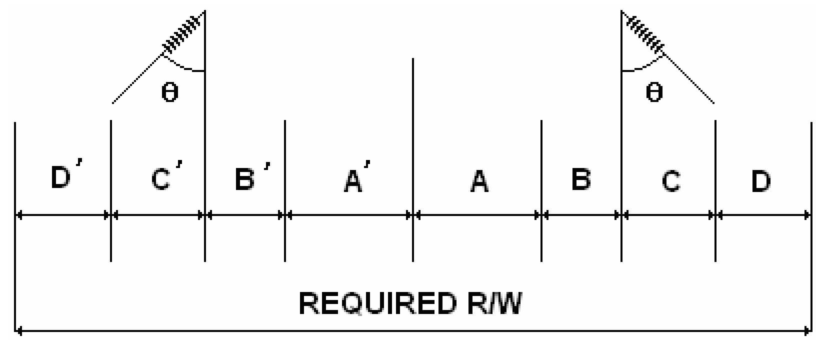


Required Distance (Right side of structure)		Width (ft)
A	Distance between end of arm conductor attachment and center of structure (115kV arm)	12
B	Structure attachment deviation due to deflection	6
C	Blowout. Obtained from PLS_CADD 3D model with Grosbeak (636 MCM) conductor at 6 psf for 115kV circuit.	20.3
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	6.6
E	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	9.6
	Required ROW (The larger value between Case 1 and Case 2) **A + B + C + D**	**44.9**

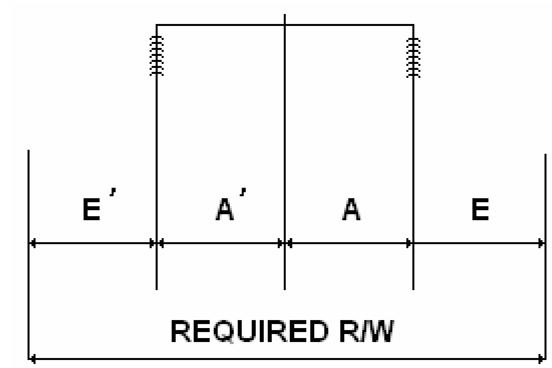
Figure 4.3-24b East Range 39l/37L Leg HVTL ROW Calculation-345kV/115kV Double Circuit, 1100 Foot Span, Left Side Structure



Case 1

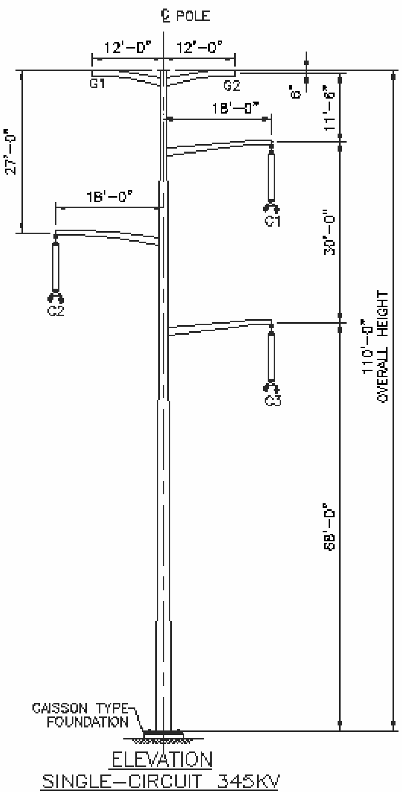


Case 2

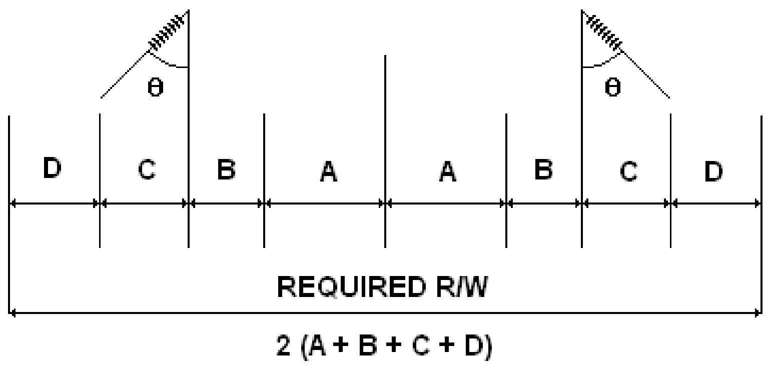


Required Distance (Left Side of Structure)		Width (ft)
A'	Distance between end of arm conductor attachment and center of structure (345kV arm)	18
B'	Structure attachment deviation due to deflection	6
C'	Blowout. Obtained from PLS_CADD 3D model with Twin Pheasant conductor at 6 psf	18.7
D'	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	10.8
E'	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	13.8
	Required ROW (The larger value between Case 1 and Case 2). **A' + B' + C' + D'**	**53.5**
Total ROW	**44.9 + 53.5**	**98.4**

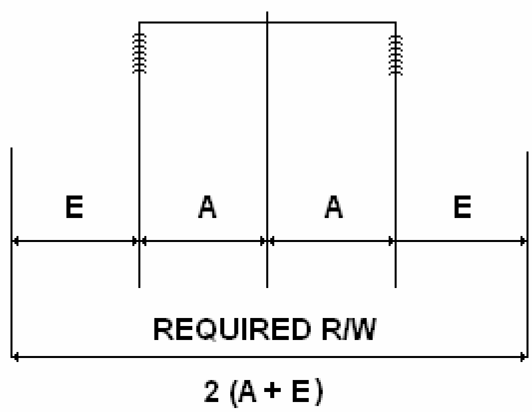
Figure 4.3-25 East Range 39L/37L Leg HVTL ROW Calculation-345kV Single Circuit Structure



Case 1



Case 2



Required Distance		Width (ft)
A	Distance between end of arm conductor attachment and center of structure	18
B	Structure attachment deviation due to deflection	5
C	Blowout. Obtained from PLS_CADD 3D model with Twin Pheasant conductor at 6 psf	12
D	Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234	10.8
E	Clearance requirement to building or objects with conductor at rest per NESC Rule 234	13.8
	Required Right of Way (The larger value between Case 1 and Case 2)	**91.6**

Figure 4.3-26 East Range Alternate 38L 345kV HVTL Route and Structure Configurations

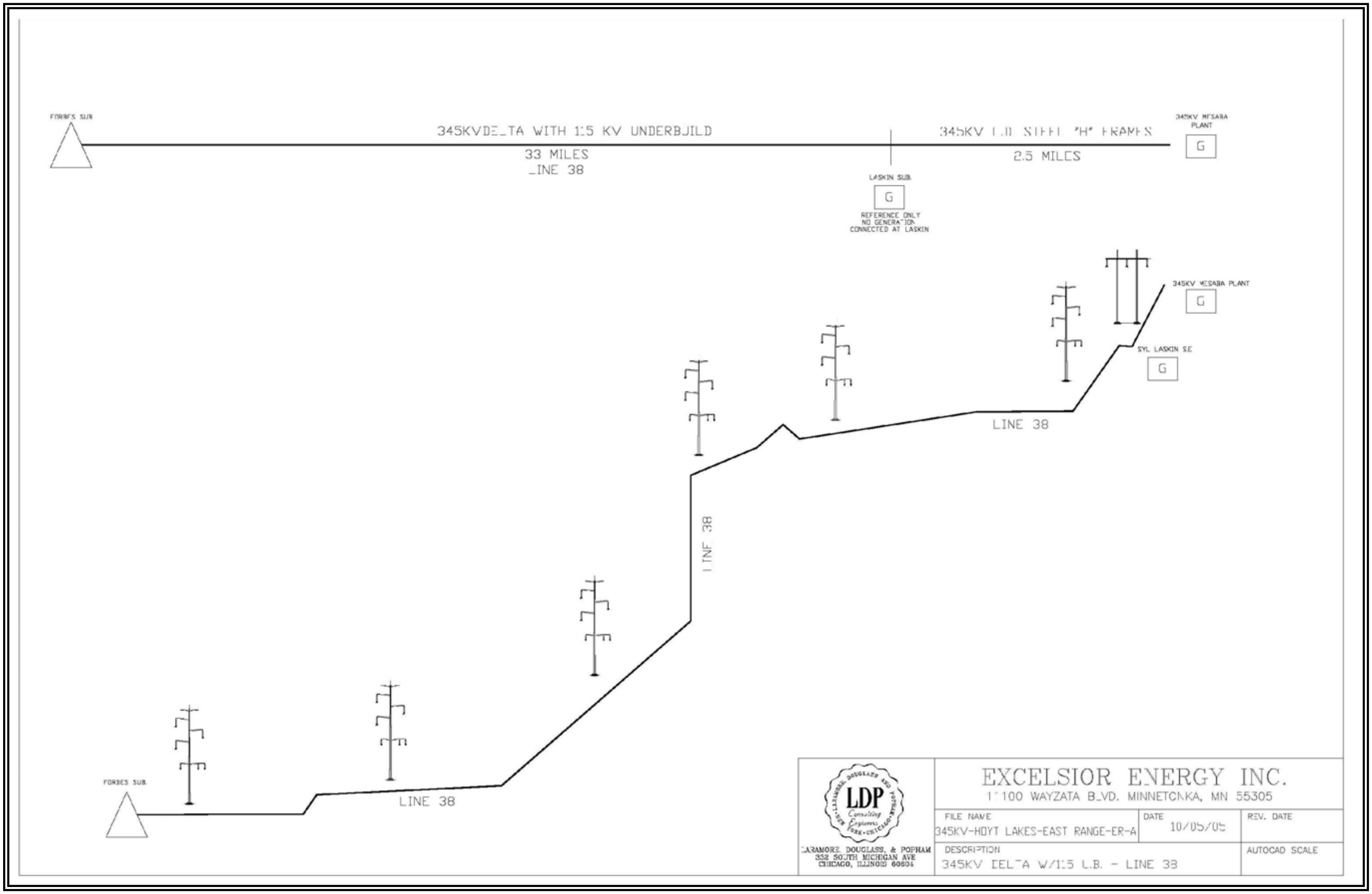
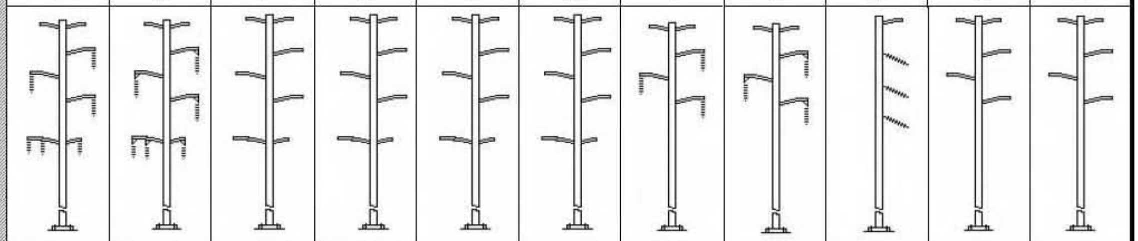


Figure 4.3-27 East Range 38L Leg HVTL Structure Summary

Mesaba Energy Project
Preliminary Corridor Structure Design for the East Route
Preliminary Structure Summary Line 38 and 43



Height	1	2	3	4	5	6	7	8	9	10	11
	SUS1_UB	SUS2_UB	STR1_UB	STR2_UB	DED1_UB	DED2_UB	SUS1	SUS2	RAN1	DED1	DED2
	0° - 2°	2°-6°	6°-15°	15°-30°	30°-60°	60°-90°	0° - 2°	2°- 15°	15°-30°	30°-60°	60°-90°
115	1										
120	13										
124	149	1	1		6	3					
129	46				1						
132					1						
133.0	25		1			1	1				
134.0	1										
137.0						1					
138.0	6										
139.0	1										
142.0	5				3					1	
147.0											1
Total	247	1	2	0	11	5	1	0	0	1	1

269 Structures

4.3.2 Conductors

Two different size conductors for each transmission line segment to be operated at a specific voltage were evaluated. The proposed conductor, listed for each line segment, was selected based on an economic analysis that estimated the lowest cost considering initial construction cost, power losses due to line characteristics and construction sequencing to account for the time value of funds. The characteristics of each conductor type operating at 230 kV are included in Table 4.3-1. Characteristics of various conductor types operating at 345kV are included in Table 4.3-2. The line impedances and power flow data for the alternative conductors considered for use are presented in this table. The rating for each conductor is presented in Table 4.3-2.

Table 4.3-1 Conductor Impedances and Power Flow Data: 230kV

	230KV ER-A/ER-B 795KCMIL Bundle	230KV ER-C 795KCMIL Bundle	230KV ER-A/ER-B 1590KCMIL	230KV ER-C 1590KCMIL	230KV WR-A 795KCMIL Bundle	230KV WR-B 795KCMIL Bundle	230KV WR-A 1590KCMIL	230KV WR-B 1590KCMIL
Pr (MW)	583.710408	582.388675	583.059919	581.651236	594.9268	591.474692	594.71364	591.148182
Vr (kV)	230	230	230	230	230	230	230	230
Ir (AMP)	1475.03605	1468.93385	1465.12214	1460.42143	1544.385	1519.8395	1535.88	1508.43805
P.F.r	0.99338839	0.99525635	0.99899573	0.99978988	0.967013	0.97692836	0.9720193	0.98376905
Sine(PFr Angle)	0.11480204	0.09728716	0.04480541	0.02049887	0.254727	0.21356727	0.2349008	0.17943929
L (mile)	35.5	38.7	35.5	38.7	10	17.5	10	17.5
R+ (Ohm)/mile	0.0703	0.0703	0.0741	0.0741	0.0709	0.0703	0.0747	0.0741
R0 (Ohm)/mile	0.6592	0.6592	0.6626	0.6626	0.629	0.6592	0.6328	0.6626
X+ (Ohm)/mile	0.56	0.56	0.7483	0.7483	0.566	0.56	0.7559	0.7483
X0 (Ohm)/mile	1.8892	1.8892	2.077	2.077	1.926	1.8892	2.116	2.077
Xc+ (M Ohm)/mile	0.1322	0.1322	0.1646	0.1646	0.1322	0.1322	0.1747	0.1646
Xc0 (M Ohm)/mile	0.2414	0.2414	0.2838	0.2838	0.2515	0.2414	0.294	0.2838
Ps (MW)	600	600	600	600	600	600	600	600
Delta(Es,Vr) DEG	11.5979972	12.6068233	15.6205642	17.0134434	3.436089	5.86102724	4.6072413	7.85460924
P loss (MW)	16.2895918*	17.6113247**	16.9400808*	18.3487643**	5.073159*	8.52530805**	5.2863559*	8.8518179**
V drop (Kv)	22.2553512	24.1610981	29.4521444	32.0039732	6.63396	11.3041845	8.7852074	14.9479028
Es (KV)	247.215918	248.242862	248.888716	249.689789	236.1152	239.928406	237.42271	241.741884
%Regulation	7.48518186	7.93167913	8.21248505	8.56077771	2.658804	4.31669839	3.2272662	5.10516678
P.F.s	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95

* When only unit 1 is in service, the two lines will operate in parallel resulting in 25% of losses shown.
** When both units are in operation, the three lines will operate in parallel resulting in reduced losses from those shown in the table.

Table 4.3-2 Conductor Impedances and Power Flow Data: 345kV

345 KV LINE IMPEDANCES AND POWER FLOW DATA (REV1)
(600 MW Generation at 0.95 Power Factor)

	345KV ER-A/ER-B 954KCMIL BUNDLE	345KV ER-A/ER-B 1272KCMIL BUNDLE	345KV WR-1A 954KCMIL BUNDLE	345KV WR-2A 954KCMIL BUNDLE	345KV WR-1B 954KCMIL BUNDLE	345KV WR-1A 1272KCMIL BUNDLE	345KV WR-2A 1272KCMIL BUNDLE	345KV WR-1B 1272KCMIL BUNDLE
Pr (MW)	593.273698	594.8309783	598.002447	598.01863	596.5632363	598.4706794	598.4315168	597.3657458
Vr (kV)	345	345	345	345	345	345	345	345
Ir (AMP)	1016.699879	1019.461745	1043.921686	1043.964	1035.081572	1044.792888	1044.748021	1036.551184
P.F.r	0.976551925	0.976462708	0.95866762	0.9586547	0.964528194	0.958618238	0.958596675	0.964456359
Sine(PFr Angle)	0.215281997	0.215686302	0.284528372	0.2845719	0.263979855	0.284694702	0.2847673	0.264242185
L (mile)	35.5	35.5	10	10	17.5	10	10	17.5
R+ (Ohm)/mile	0.0611	0.0467	0.0611	0.0606	0.0611	0.0467	0.0479	0.0467
R0 (Ohm)/mile	0.6206	0.6062	0.6206	0.6218	0.6206	0.6062	0.6074	0.6062
X+ (Ohm)/mile	0.6034	0.5947	0.6034	0.6023	0.6034	0.5947	0.5936	0.5947
X0 (Ohm)/mile	1.8334	1.8247	1.8334	1.8367	1.8334	1.8247	1.828	1.8247
Xc+ (M Ohm)/mile	0.1423	0.1402	0.1423	0.1414	0.1423	0.1402	0.1392	0.1402
Xc0 (M Ohm)/mile	0.2355	0.2333	0.2355	0.2304	0.2355	0.2333	0.2283	0.2333
Ps (MW)	600	600	600	600	600	600	600	600
Delta(Es,Vr) DEG	5.7604818	5.736769081	1.66354358	1.6609418	2.887365764	1.653606465	1.649268995	2.871788264
P loss (MW)	6.726301985*	5.169021705*	1.997552968**	1.9813671**	3.436763654**	1.529320644**	1.568483239**	2.634254243**
V drop (Kv)	10.98930946	10.83829436	3.178463278	3.172593	5.5152081	3.128901295	3.123515171	5.432383933
Es (KV)	358.6631018	357.6914871	349.3105906	349.29643	352.2938282	349.0193334	349.034321	351.7943769
%Regulation	3.960319355	3.6786919	1.249446557	1.2453411	2.114153108	1.165024163	1.169368412	1.969384615
P.F.s	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95

* When only unit 1 is in service, the two lines will operate in parallel resulting in 25% of losses shown.

** When only unit 1 is in service, lines 1A and 1B or 2A and 1B will be operating in parallel resulting in reduced losses from those shown in the table.

Table 4.3-3 Conductor Rating Data

EXCELSIOR ENERGY INC.

LDP Lamarre, Douglas and Popham Consulting Engineers New York • Chicago

Conductor Selection

Rating Ampacity Criteria

Temp	30 C / 86 F
Wind Speed	2.0 ft/s
Angle b/w wind and Cond.	90 deg
Cond. Elev	1400 ft
Sun Time	12 hrs
Cond. Lat	47 deg
Atmosphere	Clear
Day of Yr.	June 30

230 kV System

1-Generator 600MW - 1585 A (.95 PF)

Conductor Type	100C/212F
1-1590 kcm ACSR "Lapwing	1601 A
2-795 kcm ACSR " Drake"	2128 A

345 kV System

2-Generator 1200MW - 2113 A (.95 PF)

Conductor Type	100C/212F
2-954 kcm ACSR "Cardinal"	2328 A
2-1272 kcm ACSR "Pheasant"	2785 A

115 kV System

Conductor Emergency Rating

Conductor Type	135C/275F
1-954 kcm ACSR "Cardinal"	1411 A

4.3.3 Other Transmission Network Reinforcements

In addition to the necessary generator outlet HVTLs identified above, the Applicant anticipates that network reinforcements[16] will be required within other existing HVTL corridors leading to load centers and/or at substations down-network of the Blackberry and Forbes Substations. MISO is the organization with responsibility to coordinate the objective review of, and ultimately approve, all transmission-related additions and alterations. MISO's Large Generator Interconnection Agreement Procedure ("LGIP") is the process established to facilitate such review and approval.

At Excelsior's request (formally logged as MISO Queue No. 38491-01), the LGIP has been initiated and designated as Project G519. Work to-date has verified that the Blackberry 230kV Substation is an acceptable POI and that some additional network upgrades/reinforcements will likely be required to deliver the output from Mesaba One to the Xcel Energy control area.

4.3.3.1 West Range Site

4.3.3.1.1 Mesaba One Reinforcements

Excelsior has conducted preliminary power flow studies to identify potential HVTL Phase I reinforcements needed to avoid constructing new HVTLs outside existing corridors. Such reinforcements will include the following types of improvements to existing transmission lines:

- Replacing conductors (wires) to increase capacity
- Installing new towers or replacing aging towers
- Replacing insulators on existing towers so that existing lines can be used for higher kV transmission

The studies suggest that 230kV or 345kV reinforcements between MP's Clay Boswell Station (or the Blackberry Substation) and the Riverton Substation will be identified through the LGIP as part of the Phase I developments. Currently, the lines around the Blackberry Substation are heavily loaded as most of the output of Clay Boswell Units 3 and 4 (nearly 900 MW) flows through this substation.

> As noted above, MISO has performed preliminary powerflow studies of Mesaba One's injection into the existing electrical grid. The results have been analyzed and prompted additional work. MP has also completed and forwarded its requested short circuit studies to MISO. The remaining powerflow and stability studies will be done immediately following, and perhaps concurrent with, the G477 studies (Queue No. 38280-01) associated with the East Range Site. The System Impact Study report is expected to be completed in April/May of 2006.

[16] Network reinforcements are defined as upgrades to the existing transmission system designed to eliminate new constraints on existing generating resources that would otherwise interfere with the existing generator's capability to place into commerce the amount of energy it provided to existing load centers prior to introducing new generating capacity at a point intermediate to such pre-existing load centers.

4.3.3.1.2 Mesaba Two Reinforcements

Existing 230kV lines from Blackberry Substation to the Arrowhead Substation (near Duluth) and to the Riverton Substation (near Brainerd) are likely candidates for upgrading and/or double circuiting to increase transfer capabilities to the south commensurate with the addition of Mesaba Two.

Existing 230kV HVTL corridors connect the Blackberry and Arrowhead 230/115kV Substations (65 miles in length) and the Blackberry and Riverton 230/115kV Substations (80 miles in length). In the powerflow studies performed by Excelsior, the circuits on these corridors were upgraded to 345kV as part of a combined generator outlet/network reinforcement delivery concept for the Phase II Development. The studies also indicated that additional 345kV reinforcements would likely be needed beyond the Riverton substation to Great River Energy's Benton County Substation to accommodate Mesaba Two. Excelsior has recently submitted to MISO an LGIP request for Mesaba Two to confirm the required network reinforcements for the Phase II Development.

4.3.3.2 East Range Site

4.3.3.2.1 Mesaba One Reinforcements

In addition to the East Range IGCC Power Station's GO HVTLs identified above, Excelsior anticipates that network reinforcements would be required within other existing HVTL corridors leading to load centers and/or at substations down-network of the Forbes Substation. Based upon preliminary system studies, interconnecting the IGCC Power Station directly to the Forbes Substation results in minimal impacts on the underlying MP system, including the already congested "North Shore Loop". The studies also show that network upgrades will be necessary from the Forbes Substation south at least to Duluth, and possibly to the Twin Cities, to minimize potential impacts on the existing Winnipeg-Forbes-Twin Cities 500kV Intertie.

The MISO large generator interconnection process has been initiated to evaluate the Forbes Substation as the POI and to determine what network upgrades are necessary to deliver the output of Mesaba One to the Xcel Energy control area (Twin Cities).

4.3.3.2.2 Mesaba Two Reinforcements

Based upon Excelsior's preliminary system powerflow studies, the addition of two new 345kV circuits in existing corridors between the Forbes Substation and the Arrowhead Substation (located in Proctor, MN near Duluth) and then continuing on from the Arrowhead Substation into the Twin Cities 345kV system via existing routes appears to provide a robust reinforcement plan sufficient for both Mesaba One and Mesaba Two. It may be sufficient to upgrade existing 230kV circuits between these locations to 345kV for one of these circuit paths. Such upgrades would involve replacing existing HVTL towers with double circuit structures similar to what has been proposed for the 39L/37L and 38L GO HVTLs. This would minimize, if not eliminate, the need to acquire new ROWs.

4.4 TRANSMISSION LINE CONSTRUCTION

Areas that are stable and dry can be worked on during summer months, with difficult swampy areas reserved for winter construction. In areas where the frozen ground will not support weight, cribbing or matting is layed on the ground, to spread the weight. Most vehicle traffic will use the ROW for construction, with possible placement of a few access roads to the ROW. In some areas additional temporary ROW will be required for access. Erosion control measures will be implemented to minimize erosion during construction.

The steel structures will be supported by a drilled concrete pier foundation that will require an excavation 15 to 55 feet deep and 7 to 12 feet in diameter. Concrete piers can easily be drilled in frozen soils, with curing agents added to the concrete mix while pouring. In peat, special foundation structures will be required as shown in Figure . Once the concrete has cured, towers are assembled and erected. Poles will be delivered to structure locations and placed on the right-of-way and out of the clear zone of any adjacent roadways or designated pathways. Insulators and other hardware will be attached while the pole is on the ground, and the pole will then be lifted, placed, and secured on the foundation by a crane or similar heavy equipment.

Once the structures have been erected, conductors will be installed by establishing a stringing setup area on a portion of the right-of-way. The conductors are added after the towers are in place and dressed out. Pulleys placed on the insulators allow the cable to be pulled along the route with pulling and tensioning equipment, thereby allowing the wire to be pulled over the swampy areas. Conductor stringing operations will also require brief access to each structure to secure the conductor cable to the insulators or to install shield wire clamps once final tensioning is completed. Temporary guard or clearance poles will be installed as needed over existing distribution or communication lines, streets, roads, highways, railways or other obstructions after any necessary notifications are made and permits obtained. This ensures that conductors will not obstruct traffic or contact existing energized conductors or other cables.

Construction crews will comply with local, state, National Electric Safety Code (NESC) and other applicable standards regarding clearance to ground, clearance to crossing utilities, clearance to buildings, right-of-way widths, erection of power poles and stringing of transmission line conductors. During construction, crews will attempt to limit ground disturbance wherever possible. Disturbed areas will be restored to their original condition to the extent practicable and as negotiated with landowners. Post-construction reclamation activities include removing and disposing of debris, dismantling all temporary facilities (including staging and lay down areas), leveling or filling tire ruts, employing appropriate erosion control measures, and reseeding areas disturbed by construction activities with vegetation similar to that which was removed.

Construction for the East Range is expected to be spread over two years, with the West Range preferred transmission plan likely being completed in one winter season.

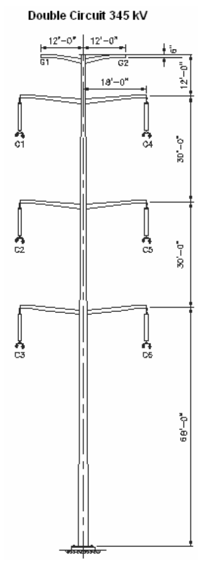
4.5 TRANSMISSION LINE OPERATION AND MAINTENANCE

The owners will periodically perform inspections, maintain equipment and make repairs over the life of the line. As well, the owners will also conduct routine maintenance approximately every five years to remove undesired vegetation that may interfere with the safe and reliable operation of the HVTL.

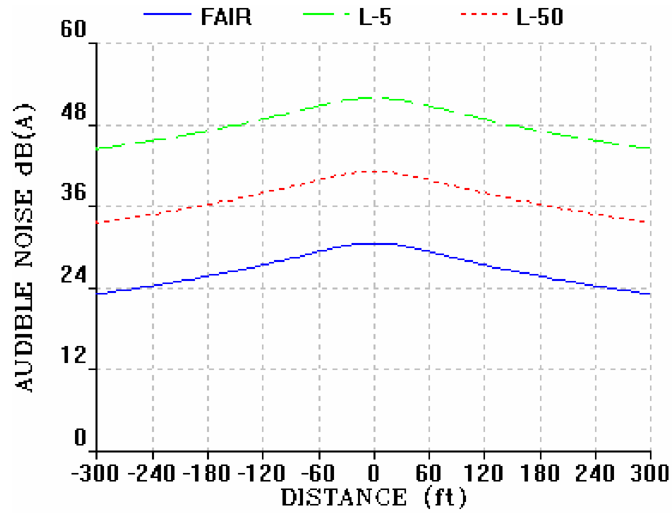
4.6 ELECTRIC AND MAGNETIC FIELDS AND NOISE

The electric and magnetic fields (EMF) and noise levels that are modeled to be generated by the proposed transmission lines are shown in Figures 4.6-1 through 4.6-12. As designed, all such levels will be in compliance with applicable State and Federal standards.

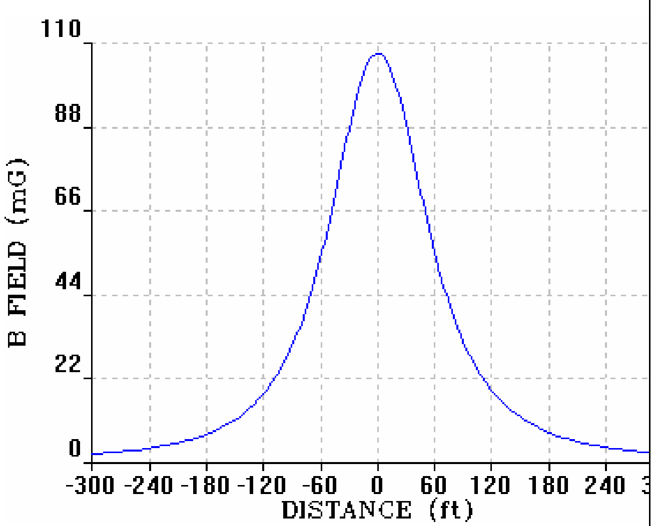
Figure 4.6-1 EMF Calculations for Plan A 345kV Preferred and Alternate Route Vertically Configured Double Circuit Structure



Audio Noise



Magnetic Field



Electric Field

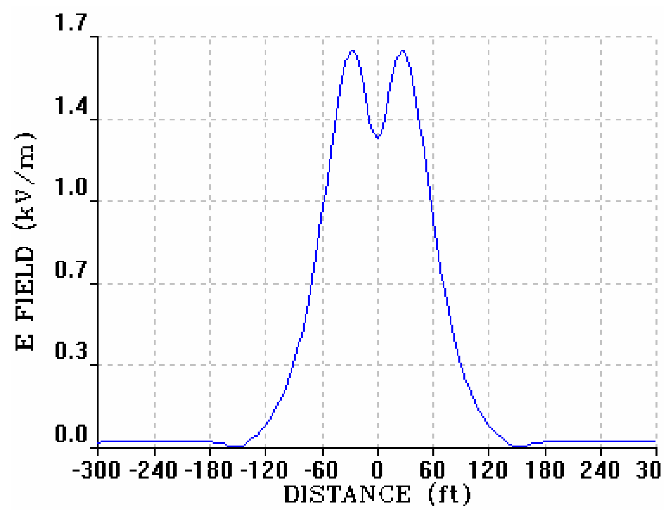


Figure 4.6-2 EMF Calculations for Plan A 345kV Preferred and Alternate Route Vertically Configured Double Circuit Structures With 115kV Underbuild

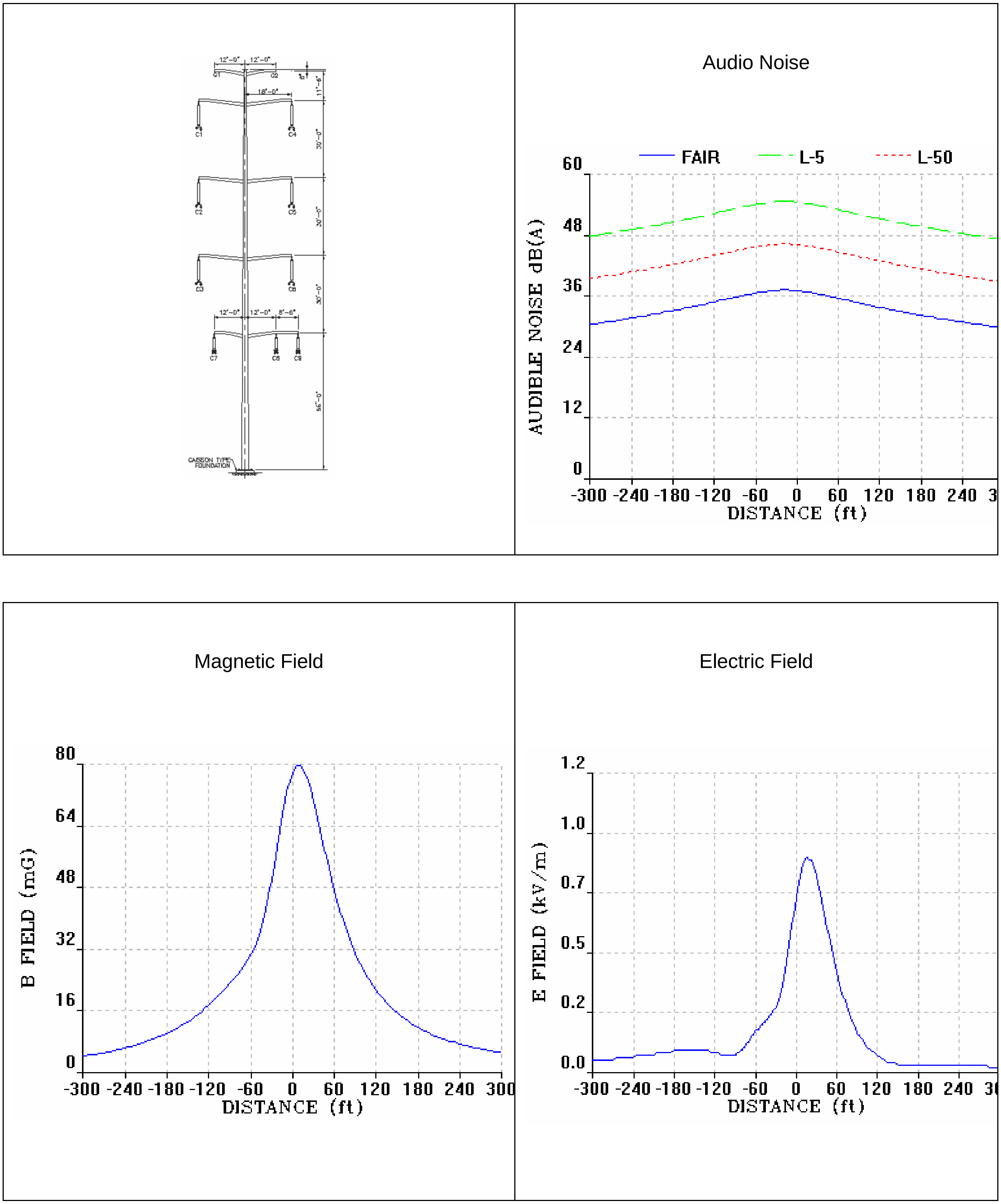
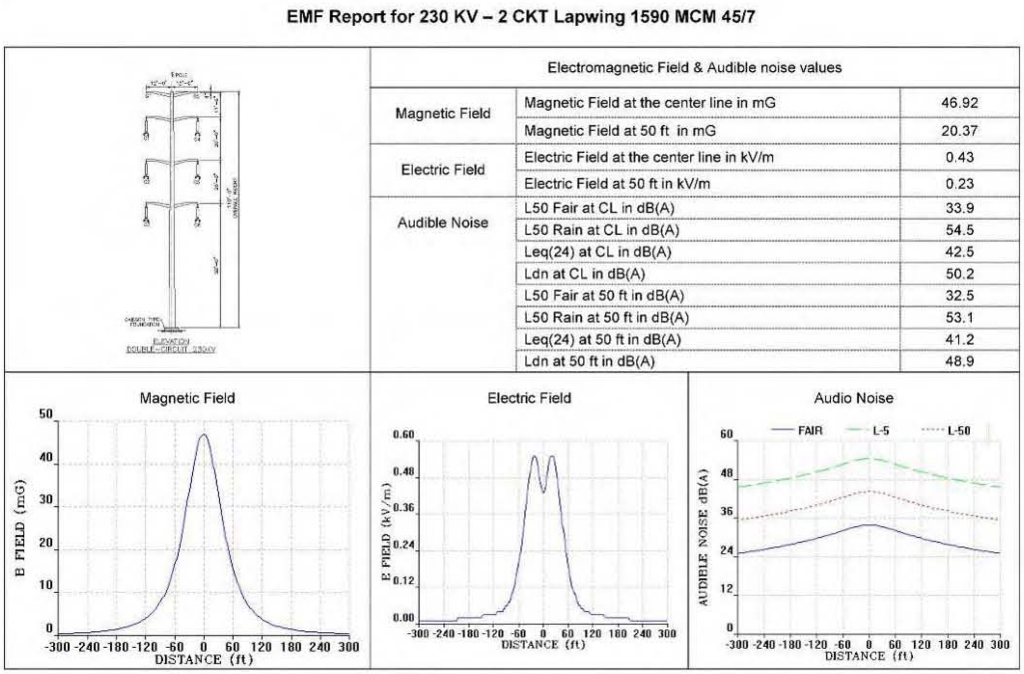
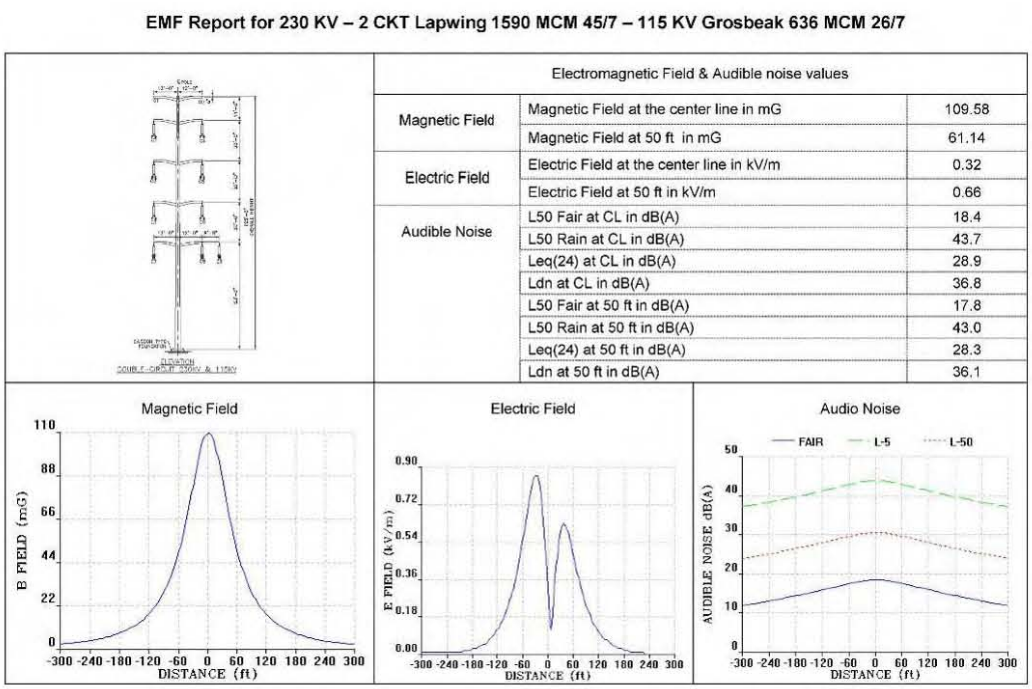


Figure 4.6-3 Electric and Magnetic Field and Noise Values-230kV Double Circuit HVTL



Electromagnetic Field & Audible noise values		
Magnetic Field	Magnetic Field at the center line in mG	46.92
	Magnetic Field at 50 ft in mG	20.37
Electric Field	Electric Field at the center line in kV/m	0.43
	Electric Field at 50 ft in kV/m	0.23
Audible Noise	L50 Fair at CL in dB(A)	33.9
	L50 Rain at CL in dB(A)	54.5
	Leq(24) at CL in dB(A)	42.5
	Ldn at CL in dB(A)	50.2
	L50 Fair at 50 ft in dB(A)	32.5
	L50 Rain at 50 ft in dB(A)	53.1
	Leq(24) at 50 ft in dB(A)	41.2
	Ldn at 50 ft in dB(A)	48.9

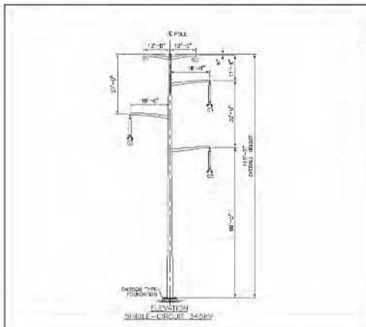
Figure 4.6-4 Electric and Magnetic Field and Noise Values-230kV Double Circuit HVTL with 115kV Underbuild



Electromagnetic Field & Audible noise values		
Magnetic Field	Magnetic Field at the center line in mG	109.58
	Magnetic Field at 50 ft in mG	61.14
Electric Field	Electric Field at the center line in kV/m	0.32
	Electric Field at 50 ft in kV/m	0.66
Audible Noise	L50 Fair at CL in dB(A)	18.4
	L50 Rain at CL in dB(A)	43.7
	Leq(24) at CL in dB(A)	28.9
	Ldn at CL in dB(A)	36.8
	L50 Fair at 50 ft in dB(A)	17.8
	L50 Rain at 50 ft in dB(A)	43.0
	Leq(24) at 50 ft in dB(A)	28.3
	Ldn at 50 ft in dB(A)	36.1

Figure 4.6-5 Electric and Magnetic Field and Noise Values-345kV Delta Tower HVTL

Electromagnetic Field Report for 345 KV – 1 CKT Delta Bundle (• •) Pheasant 1272 MCM 54/19



Electromagnetic Field & Audible noise values		
Magnetic Field	Magnetic Field at the center line in mG	130.82
	Magnetic Field at 50 ft in mG	93.58
Electric Field	Electric Field at the center line in kV/m	1.54
	Electric Field at 50 ft in kV/m	1.53
Audible Noise	L50 Fair at CL in dB(A)	25.4
	L50 Rain at CL in dB(A)	47.8
	Leq(24) at CL in dB(A)	34.6
	Ldn at CL in dB(A)	42.4
	L50 Fair at 50 ft in dB(A)	24.9
	L50 Rain at 50 ft in dB(A)	47.2
	Leq(24) at 50 ft in dB(A)	34.1
	Ldn at 50 ft in dB(A)	41.9

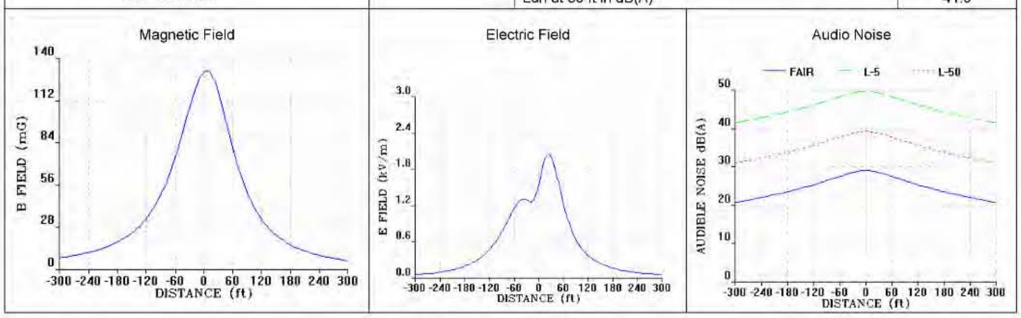
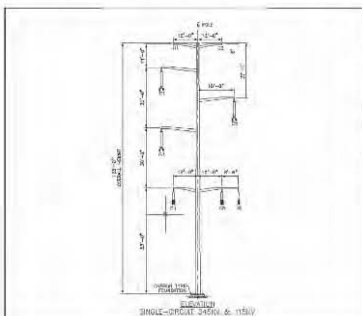


Figure 4.6-6 Electric and Magnetic Field and Noise Values-345kV Delta Tower HVTL with 115kV Underbuild

EMF Report for 345 KV – 1 CKT Delta Bundle (• •) Pheasant 1272 MCM 54/19 – 115 KV Grosbeak 636 MCM 26/7



Electromagnetic Field & Audible noise values		
Magnetic Field	Magnetic Field at the center line in mG	151.60
	Magnetic Field at 50 ft in mG	101.05
Electric Field	Electric Field at the center line in kV/m	0.806
	Electric Field at 50 ft in kV/m	1.32
Audible Noise	L50 Fair at CL in dB(A)	24.0
	L50 Rain at CL in dB(A)	46.6
	Leq(24) at CL in dB(A)	33.2
	Ldn at CL in dB(A)	41.0
	L50 Fair at 50 ft in dB(A)	23.6
	L50 Rain at 50 ft in dB(A)	46.1
	Leq(24) at 50 ft in dB(A)	33.8
	Ldn at 50 ft in dB(A)	40.6

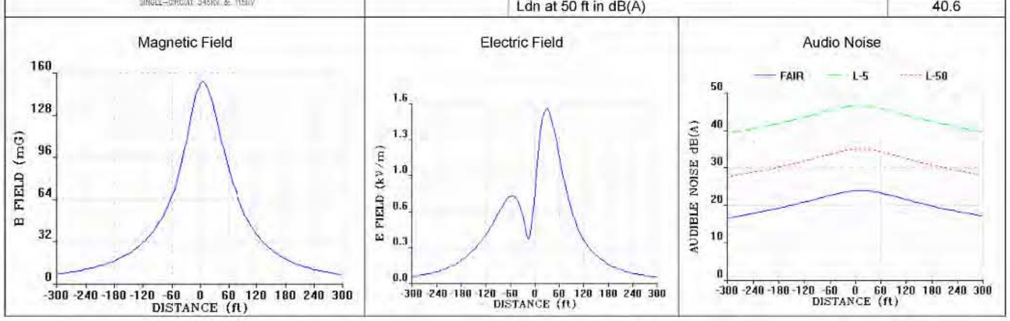
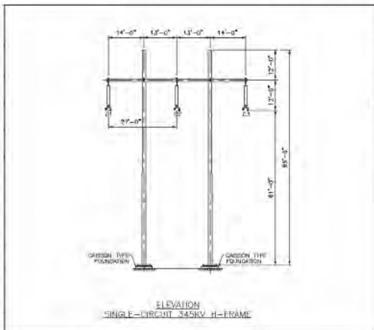


Figure 4.6-7 Electric and Magnetic Field and Noise Values-345kV H-Frame HVTL

Electromagnetic Field Report for 345 KV – 1 CKT H-Frame Bundle (• •) Pheasant 1272 MCM 54/19



Electromagnetic Field & Audible noise values		
Magnetic Field	Magnetic Field at the center line in mG	184.86
	Magnetic Field at 50 ft in mG	122.08
Electric Field	Electric Field at the center line in kV/m	0.6
	Electric Field at 50 ft in kV/m	2.0
Electric Audible Noise	L50 Fair at CL in dB(A)	29.2
	L50 Rain at CL in dB(A)	50.2
	Leq(24) at CL in dB(A)	37.8
	Ldn at CL in dB(A)	45.6
	L50 Fair at 50 ft in dB(A)	27.8
	L50 Rain at 50 ft in dB(A)	48.9
	Leq(24) at 50 ft in dB(A)	36.5
	Ldn at 50 ft in dB(A)	44.2

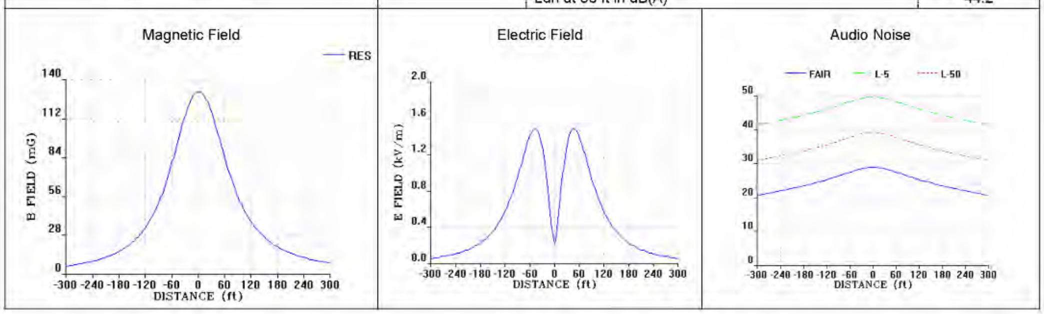
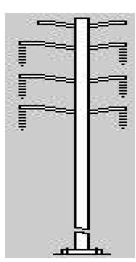


Figure 4.6-8 Electric and Magnetic Field and Noise Values-345kV/115kV Double Circuit Delta Tower HVTL



Electromagnetic Field & Audible noise values		
Magnetic Field	Magnetic Field at the center line in mG	153.8
	Magnetic Field at 50 ft in mG	101.3
Electric Field	Electric Field at the center line in kV/m	2.49
	Electric Field at 50 ft in kV/m	.74
Audible Noise	L50 Fair at CL in dB(A)	24.4
	L50 Rain at CL in dB(A)	46.8
	Leq(24) at CL in dB(A)	35.3
	Ldn at CL in dB(A)	40.5
	L50 Fair at 50 ft in dB(A)	23.1
	L50 Rain at 50 ft in dB(A)	45.4
	Leq(24) at 50 ft in dB(A)	33.9
	Ldn at 50 ft in dB(A)	39.1

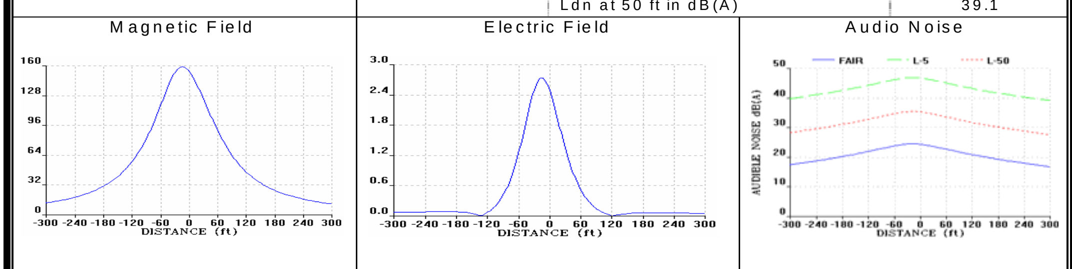
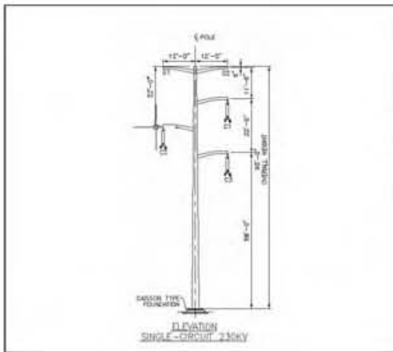


Figure 4.6-9 Electric and Magnetic Field and Noise Values-230kV Delta HVTL (Lapwing)

EMF Report for 230 KV – 1 CKT Delta Lapwing 1590 MCM 45/7



Electromagnetic Field & Audible noise values		
Magnetic Field	Magnetic Field at the center line in mG	96.59
	Magnetic Field at 50 ft in mG	57.38
Electric Field	Electric Field at the center line in kV/m	0.83
	Electric Field at 50 ft in kV/m	0.61
Audible Noise	L50 Fair at CL in dB(A)	19.4
	L50 Rain at CL in dB(A)	44.3
	Leq(24) at CL in dB(A)	29.7
	Ldn at CL in dB(A)	37.6
	L50 Fair at 50 ft in dB(A)	18.3
	L50 Rain at 50 ft in dB(A)	43.2
	Leq(24) at 50 ft in dB(A)	28.7
	Ldn at 50 ft in dB(A)	36.5

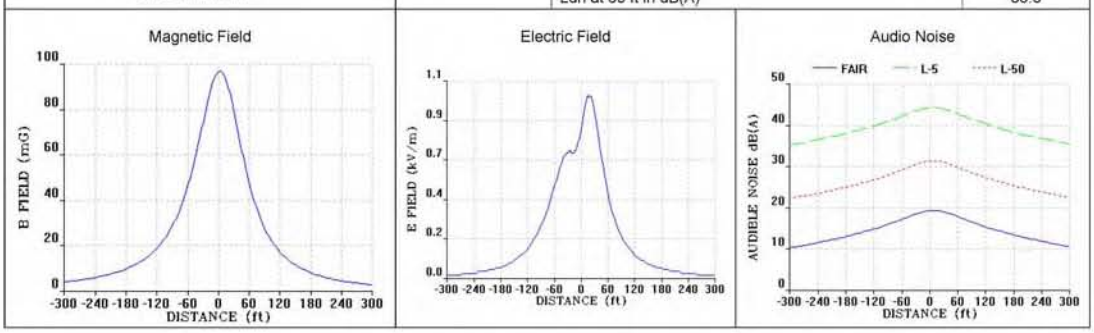
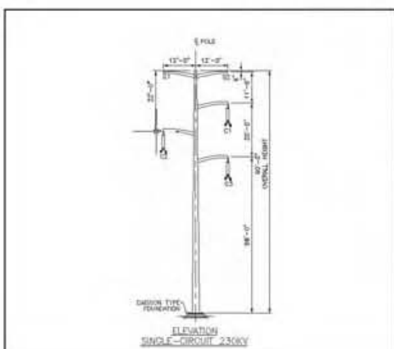


Figure 4.6-10 Electric and Magnetic Field and Noise Values-230kV Delta HVTL (Drake)

EMF Report for 230 KV – 1 CKT Delta Bundle (• •) Drake 795 MCM 26/7



Electromagnetic Field & Audible noise values		
Magnetic Field	Magnetic Field at the center line in mG	96.59
	Magnetic Field at 50 ft in mG	57.38
Electric Field	Electric Field at the center line in kV/m	1.11
	Electric Field at 50 ft in kV/m	0.80
Audible Noise	L50 Fair at CL in dB(A)	8.8
	L50 Rain at CL in dB(A)	36.9
	Leq(24) at CL in dB(A)	20.1
	Ldn at CL in dB(A)	28.0
	L50 Fair at 50 ft in dB(A)	7.8
	L50 Rain at 50 ft in dB(A)	35.9
	Leq(24) at 50 ft in dB(A)	19.1
	Ldn at 50 ft in dB(A)	26.9

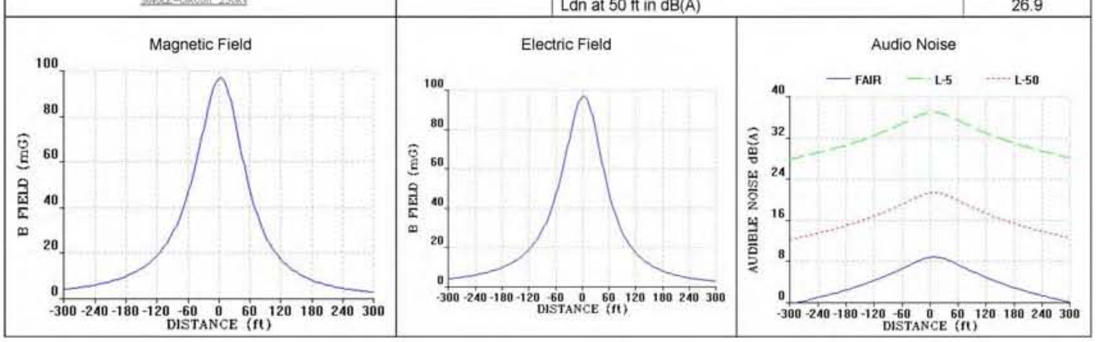
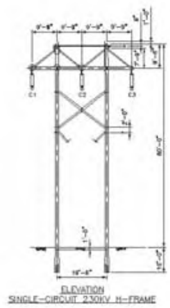


Figure 4.6-11 Electric and Magnetic Field and Noise Values-230kV H-Frame HVTL (Lapwing)

EMF Report for 230 KV – 1 CKT H-Frame Lapwing 1590 MCM 45/7



Electromagnetic Field & Audible noise values		
Magnetic Field	Magnetic Field at the center line in mG	129.88
	Magnetic Field at 50 ft in mG	74.27
Electric Field	Electric Field at the center line in kV/m	0.18
	Electric Field at 50 ft in kV/m	0.89
Audible Noise	L50 Fair at CL in dB(A)	21.0
	L50 Rain at CL in dB(A)	45.3
	Leq(24) at CL in dB(A)	31.1
	Ldn at CL in dB(A)	38.9
	L50 Fair at 50 ft in dB(A)	19.4
	L50 Rain at 50 ft in dB(A)	43.7
	Leq(24) at 50 ft in dB(A)	29.5
	Ldn at 50 ft in dB(A)	37.3

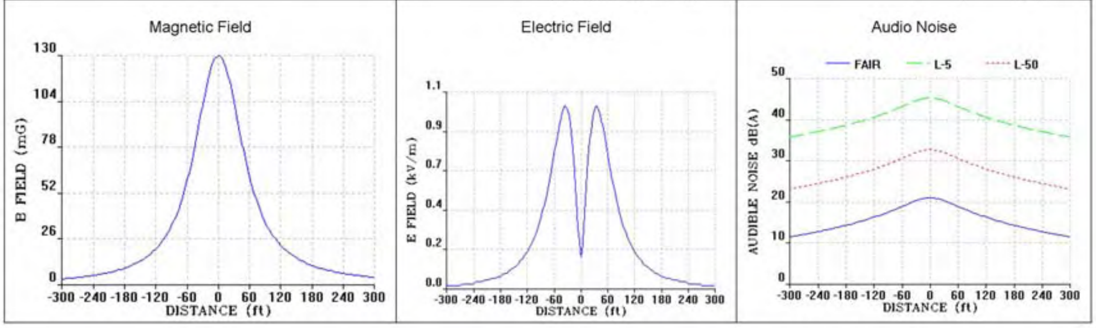
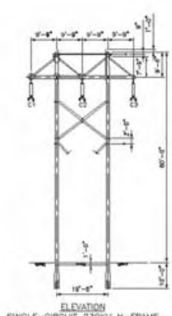
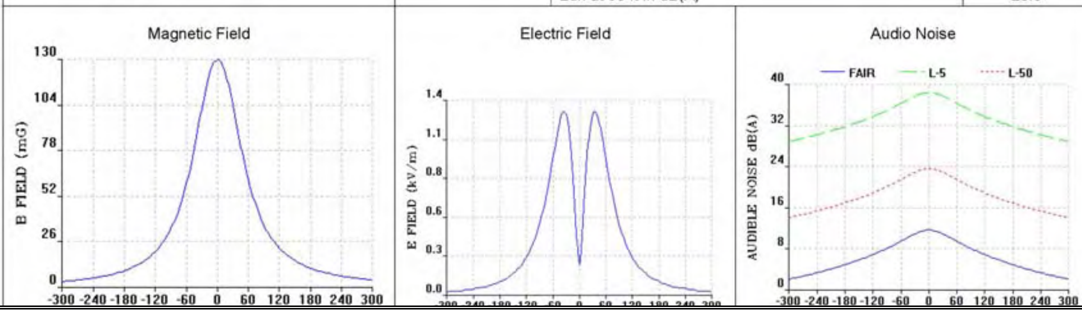


Figure 4.6-12 Electric and Magnetic Field and Noise Values-230kV H-Frame HVTL (Drake)

EMF Report for 230 KV – 1 CKT H-Frame Bundle (• •) Drake 795 MCM 26/7



Electromagnetic Field & Audible noise values		
Magnetic Field	Magnetic Field at the center line in mG	129.88
	Magnetic Field at 50 ft in mG	74.27
Electric Field	Electric Field at the center line in kV/m	0.21
	Electric Field at 50 ft in kV/m	1.16
Audible Noise	L50 Fair at CL in dB(A)	11.7
	L50 Rain at CL in dB(A)	38.4
	Leq(24) at CL in dB(A)	22.3
	Ldn at CL in dB(A)	30.2
	L50 Fair at 50 ft in dB(A)	10.0
	L50 Rain at 50 ft in dB(A)	36.8
	Leq(24) at 50 ft in dB(A)	20.6
	Ldn at 50 ft in dB(A)	28.5



4.7 TRANSMISSION LINE COST ESTIMATES

The estimated construction cost of the proposed transmission lines are presented in Table 2.8. These costs include material, labor and equipment, engineering, taxes, inspection and miscellaneous items. Presumed ROW acquisition costs are included. Costs associated with necessary system upgrades identified in the MISO process are included in the analysis.

5. GAS PIPELINE ENGINEERING AND OPERATIONAL DESIGN

This section provides details of the design of the gas pipeline that would supply the IGCC Power Station at the West Range Site as such details are known as of the date this Application. To the extent that changes in design details would be subject to review by the Minnesota Public Utilities Commission, the Applicant will submit information regarding such changes and seek a permit amendment, if required, as provided under Minn. R. 4415.0185. As discussed in Section 2, the gas pipeline that would serve the East Range is not the subject of this Application, so detailed information on that pipeline is not included. Also, as noted earlier, the West Range pipeline may be constructed and owned by local municipalities or others.

The West Range proposed gas pipeline route is shown in Figures 5.0-1 and 5.0-2.

Figure 5.0-1
West Range Natural Gas Pipeline Route-North Segment

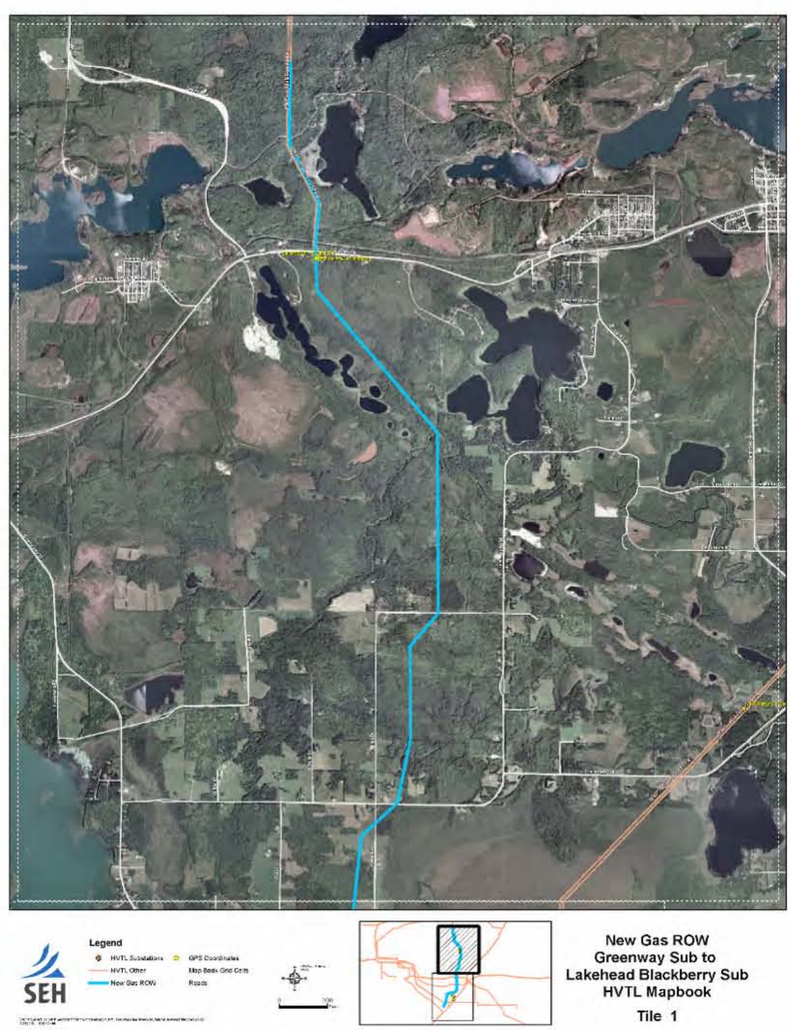
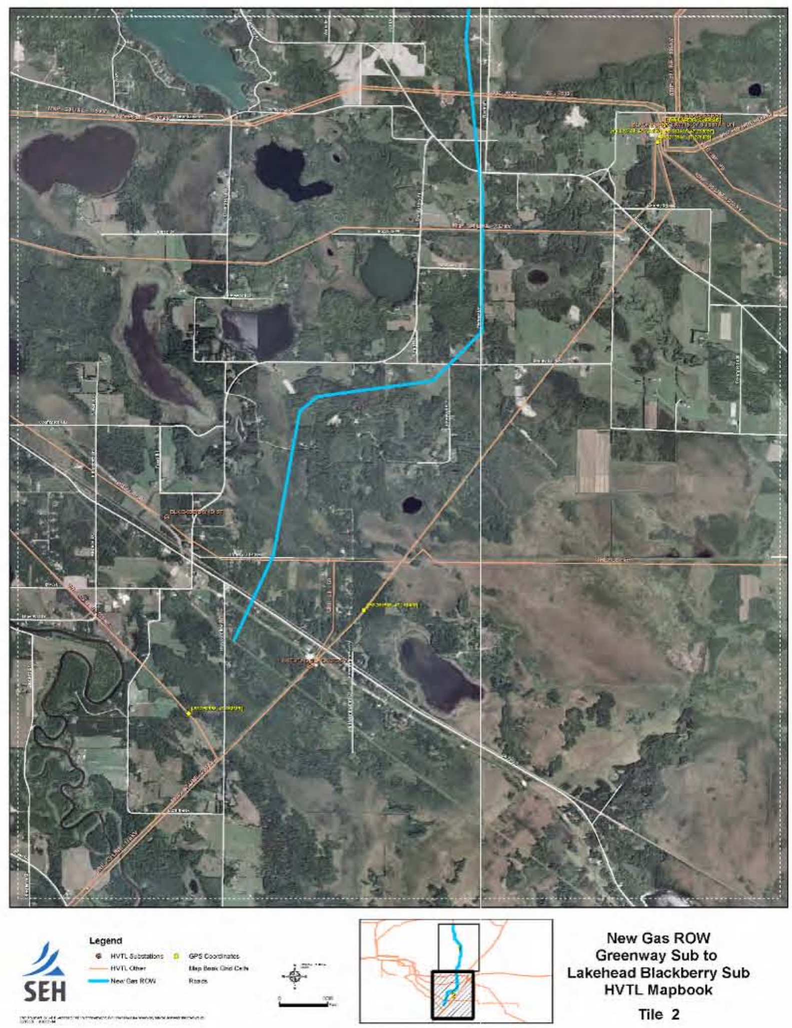


Figure 5.0-2
West Range Natural Gas Pipeline Route-South Segment



5.1 PIPELINE DESIGN SPECIFICATIONS

Pipeline design specifications for 16, 20 and 24 inch diameter pipelines are provided in Table 5.0-1 in accordance with Minn. R. 4415.0120, subp. 1.

Table 5.0-1
Natural Gas Pipeline Design Specifications

Nominal Pipe Size (Inches)	**16 OD**	**20 OD**	**24 OD**
Pipe type	**API 5L, PSL-2, ERW**		
Nominal wall thickness (inches)	0.280	0.312	0.375
Pipe Design Factor	The entire length of the pipeline ia being designed to a Class 3 location design factor of 0.50.		
Longitudinal or seam joint	1.00		
Class location and requirements	The entire length of the pipeline will be considered Class 3 for design and operation purposes		
Specified minimum yield strength (pounds per square inch gauge)	60,000	65,000	65,000
Tensile strength (pounds per square inch gauge)	75,000	80,000	80,000

5.2 OPERATING PRESSURE

The normal and maximum allowable operating pressures for the pipeline are provided in Table 5.0-2.

Table 5.0-2
Natural Gas Pipeline Design Specifications

Nominal Pipe Size (Inches)	**16 OD**	**20 OD**	**24 OD**
Normal Operating Pressure	The normal operating pressure will depend on the status of the GLG lines and the usage requirements of the IGCC Power Station.		
Maximum allowable operating pressure (pounds per square inch gauge)	1050	1014	1016

5.3 ASSOCIATED FACILITIES

Launcher and receiver facilities will be located at each end of the pipeline to allow for cleaning and internal inspection of the pipeline using intelligent pig technology. The only other associated facilities on the right-of-way beside markers required by the DOT will be cathodic protection facilities. These will consist of a rectifier and ground bed whose location will be determined by actual measurement of pipe to soil potentials along the route after the pipeline is installed.

5.4 PRODUCT DESCRIPTION AND CAPACITY INFORMATION

The only product carried in the pipeline will be sweet processed natural gas that is in compliance with the tariff filed by GLG. Material safety data sheets (MSDS) for natural gas and odorant additive are included Appendix 4.

The planned minimum and maximum design capacities of the pipeline are as follows:

A. Planned minimum design capacity – 0 million cubic feet of natural gas per day (0 Mcfd)
B. Maximum design capacity – 210 million cubic feet of natural gas per day (105 Mcfd per Phase)

5.5 LAND REQUIREMENTS

The Applicant or owner will negotiate with landowners for easements to install the pipeline on each individual tract that the route would cross. Generally, the easement terms would allow the operator the perpetual right to construct, maintain, operate, repair, replace abandon and/or remove the pipeline and related appurtenances. It would allow the grantee necessary ingress and egress to accomplish those purposes. The grantor would agree to not build any building in the easement or remove any cover from over the pipeline without the consent of the grantee. Compensation would be determined based on the value of the land at the time the easement is acquired. Landowners will be compensated for any crop damages or other merchantable item losses incurred due to construction activity.

Estimates of land use requirements are provided as follows:

- Permanent right-of-way length, average width, and estimated acreage:

  The total right-of-way length is approximately 13.2 miles. The permanent right-of-way width will be 70 feet. Estimated acreage within the permanent right-of-way is 112 acres.

- Temporary right-of-way (workspace) length, estimated width, and estimated acreage:

  An additional 30 feet of temporary workspace will be acquired along the pipeline route. Estimated additional acreage within the temporary right-of-way is 48 acres. It is anticipated that this space may not be fully utilized but would give construction crews approximately 100 feet of right-of-way for workspace if needed. Localized conditions such as roads, railroads and water body crossings may require additional temporary workspace to complete the installation. When deemed necessary, permission to use temporary workspace will be obtained from landowners adjacent to the permanent right-of-way.

- Estimated range of minimum trench or ditch dimensions including bottom width, top width, depth, and volume of excavation:

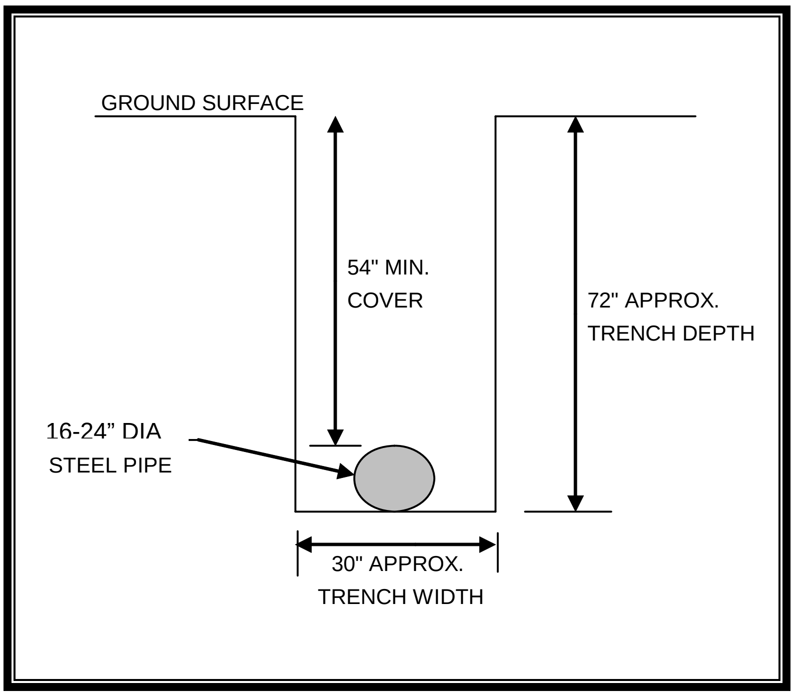
  a. Estimated trench bottom width - 30 inches

b. Estimated trench depth - 72 inches
c. Estimated trench top width - 30 inches
d. Estimated excavation – 40,000 cubic yards

- Minimum depth of cover for state and federal requirements: 54 inches

A typical cross-section for the open trench section of the proposed gas pipeline is shown in Figure 5.5-1.

Figure 5.5-1
Typical Section-Gas Pipeline Open Trench Installation



- Rights-of-way sharing or paralleling: type of facility in the right-of-way, and the estimated length, width, and acreage of the right-of-way:

The proposed pipeline route easements will parallel existing electric transmission ROW for 1.3 miles, existing gas pipeline ROW for 0.9 miles, and proposed electric transmission ROW for 4.2 miles (see Figures 5.0-1 and 5.0-2).

5.6 GAS PIPELINE CONSTRUCTION

The first step in construction of a pipeline is to prepare the Right-of-Way (ROW). The centerline of the pipeline and points of intersection tangents (PI's) will be established by a survey. Staking will be at a maximum of 400-foot intervals. A construction ROW up to 100 feet wide would be cleared. Aboveground vegetation and obstacles would only be cleared as necessary to allow safe and efficient use of construction equipment.

Storage areas up to several acres may be required for storing equipment, pipe, and other materials and would be acquired through negotiations with affected landowners.

When encountered along a ROW, fences would be adequately braced before any opening to the fence is made. Locking gates or appropriate fencing would be installed when construction in the area has been completed. Any damage to fences, gates and cattle guards would be restored to the original condition or replaced. Access and livestock control would be employed during construction to limit impact to the use of the land.

Clearing of the ROW would follow accepted industry practices and sound construction guidelines. In areas where timbering is required, trees would be cut in uniform length and stacked along the ROW based on the owner's preferences. The profile of stumps left from timbering would be as low as possible, and the removal of stumps would be limited to only that necessitated by pipeline installation. Debris created from preparation of the ROW would be disposed of using approved methods during restoration.

After the construction area has been cleared of obstacles and prior to trenching, the area would be graded as necessary to create a relatively flat work surface for the passage of heavy equipment and vehicles for subsequent construction activities. Minimal grading would be required on most of the ROW where the terrain is flat to gently sloping. In particularly difficult terrain, additional construction ROW may be required. Grading and cut-and-fill excavation would be performed to minimize effects on natural drainage and slope stability. On steep terrain or in wet areas where the ROW must be graded at two elevations (i.e., two-toning) or where diversion dams must be built to facilitate construction, the areas would be restored upon completion of construction to original conditions. Excavation and grading would only be undertaken where necessary to increase stability and decrease the gradient of unstable slopes.

The State of Minnesota requires a 54 inch minimum depth of cover in certain areas as detailed in Minn. Stat. § 116I.06, subds. 1, 2, and 3. Specifications will provide for a minimum of 54 inches of ground cover for this proposed pipeline unless waived by the landowner, or to accommodate special construction needs. Federal minimum cover requirements range from 18 inches to 48 inches depending on the circumstances encountered. For most of the proposed route it is anticipated that requirements will call for at least 48 inches of cover over the pipeline.

Most trenching would be performed using a bucket-wheel ditching machine. Conventional tracked backhoes would be used where ground conditions are unsuitable for a ditching machine and if a deeper or wider trench is required. Trench dimensions will comply with applicable land use and regulatory requirements. In wet marshy areas, draglines and clamshells are used to do the ditching. To insure the pipe is buried at the proper depth, the trench will be drained or pumped dry where practicable, or concrete coated pipe is set on weights to overcome any buoyant force. Where the pipe crosses highway or road ditches, the trench or boring is excavated deep enough to provide a minimum of 54 inches of cover over the pipe. All surfaced road crossings will be installed via directional drilling so that traffic flow will not be interrupted. Directional drilling may be used where the natural gas pipeline crosses lakes, rivers and/or streams.

In areas where there is a need to separate top and subsoil, a two-pass trenching process will be used. The first pass would remove topsoil and the second pass would remove subsoil, with soils from each of the excavations being placed in separate banks. This technique will allow for proper restoration of the soil during the backfilling process. Spoil banks will contain gaps to prevent storm runoff water from backing up or flooding. The Applicant will be required to notify the Commissioner of Agriculture if burial of the natural gas pipeline will impact cultivated agricultural land (as that term is defined in Minn. Stat. § 116.01, subd. 4). The Commisioner may participate and advise the MPUC as to whether to grant a permit for the project and the best options for mitigating adverse impacts to agricultural lands if the permit is granted. The Department of Agriculture would be the lead agency on the development of any agricultural mitigation plan required for such project (this provision also applies to HVTL route permit applications.

The operation of stringing involves the placement of pipe, from a pipe storage facility or from the pipe mill, along the ROW. Pipe will be loaded onto trucks, transported to the ROW, and unloaded by trucks equipped with booms rigged to handle pipe. The pipe would be strung either prior to or after ditching.

After the joints of pipe are strung along the trench and before the sections of pipe are joined together, individual sections of the pipe are bent to allow for uniform fit of the pipeline with the varying contours of the bottom of the trench and to accommodate changes in the route direction. A track-mounted, hydraulic pipe-bending machine is normally used for this purpose when using the size of pipe proposed for this project. The number of degrees of deflection that is allowed in a field bend is limited. Bends required that are greater than that allowed in the field are factory fabricated.

Installation of the pipe, following the bending, commences with internally swabbing the pipe, and aligning the bevels for welding. The weld material is deposited after the proper spacing and alignment of the bevels is accomplished. The line up clamps are held until enough of the weld is completed to assure weld integrity.

A critical phase of pipeline construction is the welding process. Welding is the joining of the individual sections of pipe to form the pipeline, and must be performed by a qualified welder in accordance with welding procedures that meet strict code requirements. Welders must be tested periodically to maintain the rigorous qualifications for certification of pipeline welding.

Every weld will be inspected by radiographic examination to ensure the quality and integrity of the weld. Radiographic examination is a nondestructive method of inspecting the inner structure of welds to determine if any defects are present. Defects would be repaired or removed as outlined in API 1104, which is incorporated by reference in 49 C.F.R. 192.

After welding, the girth weld and the pipe adjacent to the weld must be protected from corrosion. When the field coating or wrapping of the weld is completed, the pipeline is ready to be lowered into the trench. Special side boom tractors spread out along the pipeline simultaneously lift the line and move it over the open trench. The welded string of pipe is then lowered into the trench. An electronic holiday detector is used to monitor the coating during this operation to assure the coating is not damaged.

After the pipe has been lowered into the ditch, the trench will be backfilled. The operation must be performed in a manner that prevents damage to both the pipe and pipe coating from equipment or backfill material. Excess backfill material will be bermed over the ditch centerline to permit natural settling. Where the ditching process was used to separate top and subsoil, backfill is also installed by placing the subsoil into the trench prior to placement of the topsoil to maintain the soil segregation.

After backfilling, the pipeline will be tested to ensure that the system is capable of withstanding the operating pressure for which it was designed. In this process, the pipeline is filled with water at a pressure equal to 1.5 times the design pressure and is maintained for a minimum of eight (8) hours. Water availability and terrain conditions will determine test lengths, and test water will be disposed of pursuant to permit requirements.

The final phase of pipeline construction involves clean up and restoration of the ROW. Removal and disposal of construction debris and any surplus materials will be a part of the clean up. Restoration of the ROW surface involves smoothing by chisel plow or disc harrows or other equipment, and stabilizing when necessary. In non-cropland, the ROW will be re-vegetated according to agreement with the landowner or appropriate government agency.

5.7 GAS PIPELINE OPERATION AND MAINTENANCE

The pipeline is regulated by the Minnesota Office of Pipeline Safety (MOPS). All facilities proposed for the pipeline project will be designed, operated and maintained in accordance with DOT Minimum Federal Safety Standards in Title 49 of the C.F.R., Part 192. These regulations are meant to ensure adequate protection to the public from failures of natural gas pipelines and related facilities. Part 192 defines and specifies the minimum standards for operating and maintaining pipeline facilities, including the establishment of an Emergency Plan which will provide written procedures to minimize hazards in the event of a gas pipeline emergency. Key elements of the plan include procedures for:

- Receiving, identifying, and classifying emergency events – gas leakage, fires, explosions and natural disasters.
- Establishing and maintaining communications with local fire, police and public officials, and coordinating emergency responses.
- Making personnel, equipment, tools and materials available at the scene of an emergency.
- Priority protection of people, followed by protection of property.
- Emergency shutdown of the system and safely restoring service.

The safety standards specified in Part 192 require each pipeline operator to:

- Develop an emergency plan, working with local fire departments and other agencies to identify personnel to be contacted, equipment to be mobilized, and procedures to be followed to respond to a hazardous condition caused by the pipeline or associated facilities.
- Establish and maintain a liaison with the appropriate fire, police and public officials in order to coordinate mutual assistance when responding to emergencies.
- Establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a natural gas pipeline emergency and report it to appropriate public officials.

Before placing the pipeline in service, the operator must prepare a procedure manual for operation and maintenance of the proposed new pipeline.

Pipeline facilities will be operated and maintained in compliance with MOPS regulations. The Applicant or its operator will become a member of the Gopher State Excavators One-Call system that is vital in helping to prevent damage to underground pipelines by excavators and others engaged in construction activities. Semi-annual inspections of the pipeline right-of-way will be conducted for gas leak detection, and cathodic protection surveys would be conducted annually.

5.8 GAS PIPELINE COST ESTIMATE

The estimated construction cost of the proposed West Range pipeline is $10.2 million.

6. NON-SITE SPECIFIC ENVIRONMENTAL INFORMATION

6.1 REGIONAL SOCIAL AND ECONOMIC IMPACTS

This Section summarizes the likely social and economic impacts of the proposed facility on the Arrowhead Region as a whole. These regional impacts are largely independent of which site within the Taconite Tax Relief Area is selected. Site-specific social and economic impacts are provided in Section 7 (West Range Site) and in Section 8 (East Range Site.) The regional economic benefits estimated below are for Mesaba Phase I. However, the economic multipliers developed for the Mesaba Phase I are also applicable to Mesaba Phase II. Any potentially significant differences between the Phase I and Phase II Projects are noted where applicable. This section is divided into the following subsections:

- Study Area Population and Demographics
- Temporary and Permanent Employment
- Availability of Labor
- Economic Benefits
- Housing Availability and Real Estate Values

6.1.1 Study Area

The Mesaba Project represents the largest single new investment in northern Minnesota. The area selected for the regional study is the Minnesota Department of Employment and Economic Development's (DEED) Arrowhead Economic Development Region. This area consists of the following Minnesota counties:

- Aitkin
- Carlton
- Cook
- Itasca
- Koochiching
- Lake
- St. Louis

6.1.2 Arrowhead Region Population Trends

After gaining population in the 1970's, the Arrowhead Region experienced a decade-long population decline beginning in about 1980, in part due to a downturn in both the national steel industry as well as the local taconite industry. Table 6.1-1 below shows that the regional population declined about 8.5% between 1980 and 1990. St. Louis and Lake Counties, in the heart of the Iron Range, suffered the largest drop. Beginning in 1991, the population began to gradually increase. By 2000, the population recovered to slightly less than what it was in 1970. In comparison, over the same thirty years, the population of the State of Minnesota increased by 29%, from about 3.8 million people to 4.9 million.

Table 6.1-1.
Arrowhead Region Population Trends 1970-2000

Year	Population
1970	329,603
1980	343,344
1990	311,342
2000	322,073

Table 6.1-2 below, delineates regional population trends by county. On a percentage basis, Cook County is the fastest growing county in the region. Itasca County (West Range Site) has about the same population now that it did in 1980, and the population of St. Louis County (East Range Site) has dropped since 1980.

Table 6.1-2
Population Change Between Censuses by County for Arrowhead Region

				% Change	% Change
County	1980	1990	2000	1980-2000	1990-2000
Aitkin	13,404	12,425	15,301	14.2	23.1
Carlton	29,936	29,259	31,671	5.8	8.2
Cook	4,092	3,868	5,168	26.3	33.6
Itasca	43,069	40,863	43,992	2.1	7.7
Koochiching	17,571	16,299	14,355	-18.3	-11.9
Lake	13,043	10,415	11,058	-15.2	6.2
St. Louis	222,229	198,213	200,528	-9.8	1.2
Region	343,344	311,342	322,073	-6.2	3.4

The Minnesota State Demography Office predicts that the Arrowhead Region will continue to gain in population over the next fifteen years, increasing by about 18% by 2030. The Demography Office expects the population of St. Louis County to increase by 9% and Itasca County by 21% by 2030. During the summer the regional population increases due to the large number of temporary residents and tourists that move into the area. These seasonal increases are not reflected in census data, but should be taken into account when evaluating housing availability and transportation impacts of any new project.

6.1.3 Regional Demographics and Environmental Justice

To determine whether the Project could disproportionately impact minority or low-income residents, demographic data for the region was evaluated. Table 6.1-3 provides demographic data by race from the 2000 Census for the entire seven-county Arrowhead Region.

Table 6.1-3
2000 Census: Region 3 Arrowhead Population Profiles:
Total and Minority Populations

Regional Population (2000) by Race	Number	Percentage
White	304909	94.7
Black or African American	2171	0.7
American Indian	8342	2.6
Asian	1657	0.5
Pacific Islander (Hawaiian)	82	0
Other	653	0.2
Two or more races	4259	1.3
Total	322073	100

Table 6.1-3 indicates that at almost 95% white (including white Hispanic/Latino), the population in the region is relatively homogenous, with few concentrations of minority or low-income areas. The largest minority concentrations in the region are in central Duluth and on tribal reservations relatively distant from either the West Range or East Range Sites. The largest minority population in the Arrowhead Region is American Indian (2.6%).

6.1.4 Temporary and Permanent Workers

The University of Minnesota Duluth's Bureau of Business and Economics Research (BBER) estimated the regional and state economic and employment impacts of the Mesaba Phase I Project (BBER, 2005). The temporary and permanent employment data that were used in the BBER study are summarized in Table 6.1-4, below.

Table 6.1-4
Estimated Employment

	Temporary Construction Jobs	Permanent Operating Jobs
2007	1,286	
2008	2,708	
2009	2,728	
2010	2,985	11
2011	574	96
Typical Year		107

Total direct construction jobs are expected to peak in the year 2010 at 2,985 jobs. The majority of these jobs are skilled trades. Note that these data for construction jobs do not distinguish between full and part-time jobs, so all job numbers are reported as total jobs—not full-time equivalents.

6.1.5 Availability of Labor

Labor will be drawn from throughout the Arrowhead Region and beyond. DEED workforce data for the Arrowhead Region indicates that in 2005 the regional labor force was 167,000, with 158,000 currently employed. DEED estimates that there is, in general, an ample supply of labor in the area, but the aging population threatens to create a labor shortage in some industries by 2015 (DEED, 2005). The extent to which temporary and permanent jobs are filled by local residents is in part driven by the local labor market characteristics, the availability of unemployed or underemployed skilled construction workers, and prevailing wages. As described in Section 2.14.5, unemployment has historically been one or two percentage points higher in most of the Arrowhead Region than in the State of Minnesota as a whole. Although regional unemployment rates have declined recently, the historically persistent higher unemployment rates suggest that the region will have a skilled labor force available unless international demand for taconite, non-ferrous mining or forest products continues to increase. Some researchers believe the unemployment rates in the Arrowhead Region will return to their historically higher levels before Project construction is scheduled to begin, and the gap between the unemployment rates in the region and the rest of the state may even widen as employment in manufacturing and iron mining industries in the Northeast region again declines (BBER, 2005).

Given the labor market characteristics in northeast Minnesota, the Mesaba Project likely would not need to compete with other local businesses to attract skilled labor for permanent jobs, and thus would be able to hire operational and maintenance staff at prevailing wages. Under these circumstances, the Mesaba Project will have a positive impact on reducing the unemployment rate.

6.1.6 Housing Availability and Real Estate Value

According to 2000 census data, there are a total of about 35,300 vacant housing units in the Arrowhead Region. However, of these, 27,600 (78%) are for seasonal, recreational, or occasional use. That leaves approximately 7,700 year-round housing units potentially available for temporary or permanent housing during the construction period and after. While a detailed assessment of the location of these units relative to the two sites under consideration has not been undertaken, given the new housing development in the Hoyt Lakes area (Minnesota Power lease property, for example), and the proximity of other significant population centers to both sites, adequate housing should be available for the temporary influx of workers. Long-term, housing for the 185 new employees and their families, as well as for other indirect or induced employees in the area, would be available within commuting distance of either site.

Regarding real estate impacts, the median housing value of homes in Taconite, near the West Range Site, and in Hoyt Lakes, near the East Range Site, is about $40,000 (2000 Census).

Lakefront property in the area, however, has a considerably higher property value due to the demand for seasonal and recreational housing in the area. A few homes located near the West Range Site may be reduced in value because of the proximity of the rail operations and view of the new plant itself. However, the influx of construction and operation jobs, and the associated economic benefits of the Project will, in general, create housing demand in the area and increase income. This increased housing demand and income in turn will lead to increased real estate values in the area. There are few, if any, homes located near enough the East Range Site to be negatively affected by the project. As in Taconite, in Hoyt Lakes the influx of temporary and permanent workers for the facility would increase housing demand and increase property values.

6.1.7 Employment

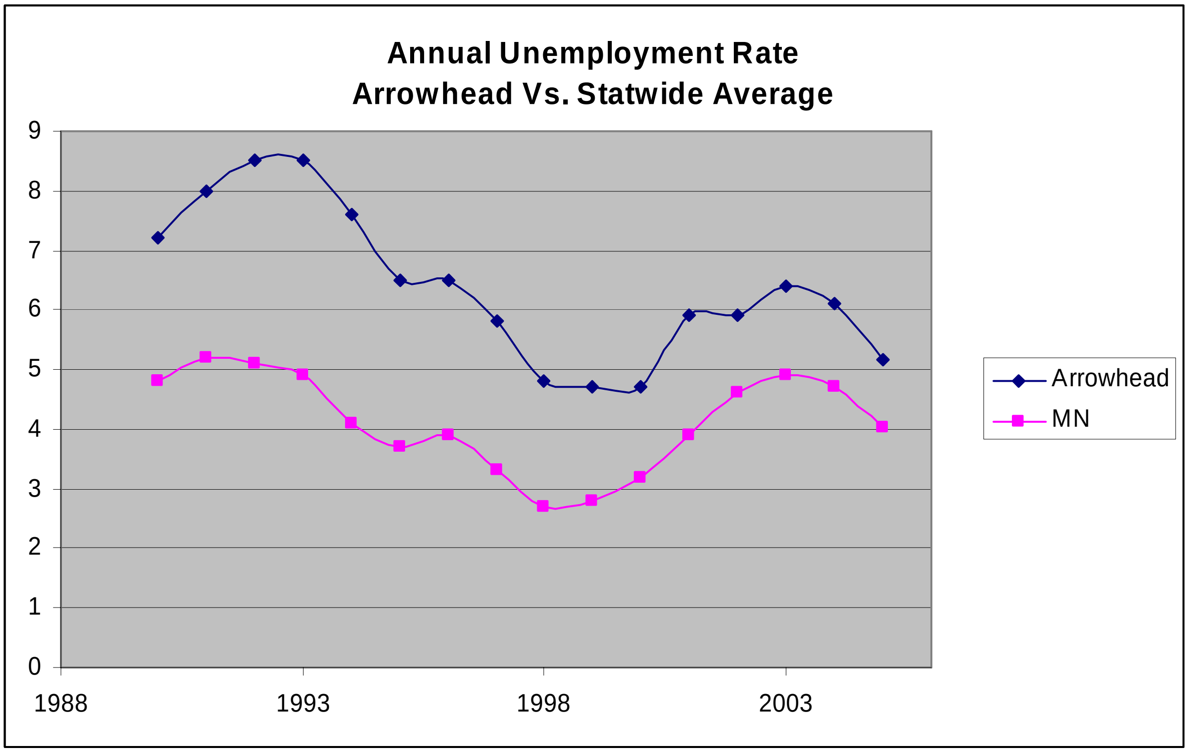
Northeastern Minnesota has historically relied on the mining and forestry industries for well-paying jobs and economic base. However, since 1970 job loss in these two industries and other changes have forced a diversification in employment. Between 2000 and 2003, jobs in mining declined by 36% (DEED, 2005). Although the mining and forestry industries have stabilized recently, both industries are now producing more output with fewer employees. These changes and the general economic crisis of the 1980's have forced the region to adopt economic diversification as a long-term strategy.

DEED collects employment data for the state of Minnesota. The 2003 data show that, as in the rest of the country, employment in the service sector is an increasingly large percentage of total employment in the Arrowhead Region. Mining now accounts for only 3% of the employment in the region, but accounts for 5% of wages paid. This indicates that mining and manufacturing jobs, while no longer a large percentage of regional employment, pay significantly higher wages than most service jobs in the area. Mining and paper production are still the two highest output industries in the region on a dollar value basis (BBER, 2005). Although mining and forestry jobs account for only a small percentage of regional jobs, these industries still account for over 15% of the jobs in Taconite (West Range Site) and Hoyt Lakes (East Range Site), both of which are located in historic mining areas of the Iron Range.

6.1.8 Unemployment

Since both temporary construction and permanent employment for the Project would be drawn from throughout the region, this section addresses regional unemployment rates. The average unemployment rate in the seven-county region averaged about 5.1% in 2005, but dropped to about 4.0% over the last four months of the year. Unemployment in the region has gradually declined over the last several years, but since 1990, the regional unemployment rate has ranged from just under 5% to over 8% annually. As shown in Figure 6.1-1, since 1980 the official unemployment rate in the Arrowhead Region has been consistently about 2% higher than the state average, and about 1% higher than the state average for the last five years. Unemployment has also dropped statewide and continued economic expansion in other areas of the state will likely increase the employment disparity between the Arrowhead Region and other parts of the State.

Figure 6.1-1



Unemployment is generally higher in most of the Arrowhead Region compared to other parts of Minnesota. This historically persistent higher unemployment rate in the Arrowhead Region suggests that northeastern Minnesota has and will continue to have a skilled labor force available for local employment in 2010 and beyond, unless labor demand from the taconite, other mining, and forest products increases. Unemployment in St. Louis County (East Range Site) and in Itasca County (West Range Site) is higher than the state as a whole. Other parts of the state, with lower unemployment, would potentially require more labor from outside the local area and region than would occur in the Arrowhead Region. The historically higher unemployment in the Arrowhead Region may indicate that any new industrial capacity in the area is likely to not only attract new residents, but also provide long-term employment to currently unemployed skilled labor living in the area.

6.1.9 Income and Poverty Rate

While there are not significant concentrations of poverty in the Arrowhead Region, overall poverty rates are higher and income is lower in the region than in the state as a whole. While the overall poverty rate is higher than the state average, there do not appear to be any substantial concentrations of extreme poverty. The annual per capita household income in the Arrowhead Region in 2003 was about $26,770, with the corresponding figure for Minnesota was significantly higher, at $34,030. As to poverty rates, according to 2000 Census information, about 11.9% of the population in the Arrowhead Region has an income below the poverty line, compared to 8.3% statewide.

The median household income of Taconite is $30,250, with 17% being below the poverty level. The median household income is higher and poverty rate is lower in Hoyt Lakes, where the median household income is $39,490 and 8.9% live below the poverty level.

6.1.10 Project Economic Benefits

BBER estimated the regional and state economic and employment impacts of the Mesaba Project using an economic impact software model called IMPLAN 2.0 (BBER, 2005). BBER modified the inputs and assumptions as necessary for the Arrowhead Region and the State of Minnesota. Detailed modeling assumptions, algorithms, and results are available in the BBER report. In summary, using construction and operating cost and employment estimates provided by the Applicant, BBER used the IMPLAN 2.0 model to predict the secondary (indirect and induced) economic and job multiplier benefits of the Mesaba Project for both the Arrowhead Region and the State of Minnesota. The economic development benefits are similar for either the West Range or East Range Site.

6.1.10.1 Model Inputs

Table 3.14-2 summarizes the major construction cost assumptions that BBER used as inputs to the IMPLAN Model to estimate the additional employment and economic impacts generated by the Project during construction.

Table 6.1-5
Construction Cost Inputs and Jobs for IMPLAN Model, in 1994 Dollars

	Capital Costs	Labor, Rent, Interest, Profits	Total Expenditure	Total Construction Jobs
2007	$ 60,585,936	$ 69,404,248	$ 129,990,184	1,286
2008	127,629,088	146,205,568	273,834,656	2,708
2009	128,577,236	147,291,520	275,868,756	2,728
2010	140,670,992	161,145,744	301,816,736	2,985
2011	27,029,352	30,963,492	57,992,844	574
Total	$ 484,492,424	$ 555,010,572	$ 1,039,502,996	N/A
Note: Jobs are full *and* part time. Current capital costs estimates are higher than those indicated.				

As shown in Table 6.1-5 based on the information provided in early 2005, BBER assumed a total project construction cost of $1.039 billion, consisting of $484.5 million capital costs and $555 million in labor and other costs. (Note that such costs are lower than current estimates.) Assumed construction costs are shown for each year of the expected five-year construction period. Total direct construction jobs are expected to peak in the year 2010 at 2,985 jobs. Note that the IMPLAN 2.0 model does not distinguish between full and part-time jobs, so all job numbers are reported as total jobs—not full-time equivalents.

Table 6.1-6, below, provides the operating cost assumptions used in the IMPLAN 2.0 model, for the start up years of 2010 and 2011, and for a typical operation year.

Table 6.1-6
Operating Cost and Job Inputs Used for IMPLAN 2.0 model, in 2004 Dollars

	Operating Cost	Wages, Rents, Interest, and Profit	Total Expenditure	Total Operating Jobs
2010	$8,883,032	$21,121,438	$30,004,470	11
2011	79,979,536	190,169,680	270,149,216	96
Typical Year	88,866,144	211,299,648	300,165,792	107
Note: Jobs are full and part time.				

As shown in Table 6.1-6, BBER assumed total project operating expenditures during a typical year to be about $300 million dollars, consisting of $211 million per year in wages, rents, interest and profits, and about $88.8 million per year in fuel, material, and other operating costs. BBER assumed 107 total new jobs (full and part-time) would be directly created to operate the plant.

6.1.10.2 Model Results

In order to understand the IMPLAN model results, the following three terms must be defined: (1) Direct Effects, (2) Indirect Effects, and (3) Induced Effects.

"**Direct Effect**" means the direct expenditures or jobs created by the Mesaba Project. The Applicant provided this information to BBER.

"**Indirect Effect**" means jobs created and spending generated by local companies to provide goods and services to support the project; these jobs may be more likely than construction jobs to come from local area. BBER estimated these data using the IMPLAN 2.0 model.

"Induced Effects" means expenditures and jobs due to increased consumer spending created by increased local and regional disposable income. BBER estimated these data using the IMPLAN 2.0 model.

Table 6.1-7, below, shows the BBER modeled economic output created by the Mesaba Project in the Arrowhead Region for each year of the five-year construction period. Table 6.1-8 shows the BBER modeled number of jobs created. Both the temporary construction jobs and the permanent operating jobs are likely to result in significant induced effects to the local economies near the new facility due to workers' spending in the region. Some of these induced impacts would be long term, resulting in significant benefits to the local economy.

6.1.10.2.1 Construction Period Economic and Employment

Table 6.1-7 shows the IMPLAN 2.0 modeled economic activity expected in the Arrowhead Region during the five-year construction period as a result of the Mesaba Project.

Table 6.1-7
Construction Period Economic and Job Impacts for Arrowhead Region, from IMPLAN Model, in 2004 Dollars

	Direct	Indirect	Induced	Total
Capital Cost	$ 484,492,424	$ 84,512,618	$ 133,386,670	$ 702,391,740
Value Added	$ 555,010,572	$ 94,839,722	$ 220,531,166	$ 870,381,467
Total Output	$ 1,039,502,996	$ 179,352,340	$ 353,917,836	$ 1,572,773,207

These data show that based on estimated direct construction costs of about $1.04 billion, BBER calculates that during construction the Project (Phase I alone) would generate about $179 million in indirect economic activity and $354 million in induced economic activity in the Arrowhead Region, for a total construction period output of about $1.57 billion. This results in a construction period regional output multiplier of about 1.5. (That is, $1.57 billion in total estimated regional output divided by $1.04 million in construction costs.) This construction period economic multiplier remains valid at higher construction costs. That is, if estimated construction costs increase, the modeled regional and state economic activity due to construction would increase proportionately as well.

The IMPLAN 2.0 modeling results for jobs created in the region during project construction are shown below in Table 6.1-8. The IMPLAN model estimates that in addition to 2,985 jobs required directly in the peak construction year of 2010, an additional 1,776 jobs would be indirectly created or induced in the region, for a total of 4,761 temporary construction jobs for the peak year of 2010.

Table 6.1-8
Construction Period Jobs Created in Arrowhead Region, in Total Jobs, Both Full-Time and Part-Time, Based on IMPLAN 2.0 Modeling

	Direct	Indirect	Induced	Total
2007	1,286	217	548	2,051
2008	2,708	457	1,155	4,320
2009	2,728	460	1,163	4,352
2010	2,985	503	1,273	4,761
2011	574	97	245	615
Note: Jobs are counted as full and part-time employment				

In the peak year of 2010, in addition to 2,985 direct construction jobs, 503 new indirect jobs are expected to be created in the region to provide goods and services to the Project itself, distributed across a number of industries, including architectural and engineering services, wholesale trade, truck transportation, rental and maintenance of heavy machinery, food and beverage services, and insurance and real estate industries. In addition, another 1,273 new induced jobs are modeled to be created due to increased consumer spending in the region, in industries such as wholesale trade, food and beverage services, general merchandise stores, building materials, real estate and healthcare industries. Overall, the Project was estimated to create 4,761 jobs in the region in the peak construction year.

6.1.10.2.2 Operating Period Economic and Employment Impacts

Although the modeled economic and job benefits of project construction are considerable, they would be temporary—extending through about five years, with peak impacts concentrated during a three-year period. (Again, assuming the construction impact of Phase I only.) Construction of Phase II would considerably extend this temporary period and bring additional extended benefits to the region and state. Permanent operating benefits and jobs would last the entire life of the plant. Operating period economic activity impacts for Phase I are shown at Table 6.1-9, followed by the estimate of jobs created in Table 6.1-10.

Table 6.1-9
Total Economic Impacts From IMPLAN Model for Typical Year, Economic Output in 2004 Dollars

	Direct	Indirect	Induced	Total
Operating Costs (raw materials, fuel, other)	$ 88,866,144	$ 12,010,121	$ 16,298,309	$ 117,174,567
Value-Added	211,299,648	11,325,331	26,968,493	249,593,489
Total Output	300,165,792	23,335,452	43,266,802	366,768,056

As shown in Table 6.1-9 based on direct annual operating expenditures of about $300 million per year, BBER estimates that the Phase I Mesaba Project would typically generate an additional $66 million in indirect economic activity ($23 million) and induced spending ($43 million) in the Arrowhead Region. Therefore, the operation period regional multiplier is about 1.2. As described in detail in the BBER Report, the statewide economic multiplier is slightly higher at about 1.28.

Table 6.1-10 summarizes Mesaba One’s estimated impact on job creation in the Arrowhead Region.

Table 6.1-10
Operating Period Jobs Created by Project, From IMPLAN Model, Based on 107 Direct Part-Time and Full-Time Jobs at the Plant

	Direct	Indirect	Induced	Total
Typical Year	107	157	134	398

Table 6.1-10 shows that the Applicant expects to need about 107 full and part-time employees to operate Mesaba One. In addition to these direct jobs, the IMPLAN model predicts that the Mesaba One would indirectly create an additional 157 permanent jobs across a number of industries, including architectural and engineering services, wholesale trade, truck transportation, rental and maintenance of heavy machinery, food and beverage services, and insurance and real estate industries. The IMPLAN 2.0 model estimates the Project would generate an additional 134 permanent jobs because of induced impacts from increased consumer spending in local industries such as wholesale trade, food and beverage services, general merchandise stores, building materials, real estate and healthcare industries, for a total regional increase of 398 full and part-time jobs in a typical operating year. As described in the BBER Report, statewide employment estimates are slightly higher than for the region alone.

A decrease in unemployment and increase in worker productivity will generally translate into higher individual incomes. Such enhanced incomes, in turn, result in reductions in poverty, unemployment benefits, and crime rates, all of which require more public spending for law enforcement activities, social benefits, and health care and other support costs. Researchers have found evidence that unemployment also negatively affects physical and psychological well-being (such as increased alienation, low self esteem, and depression). Such conditions discourage workers from actively searching for work and result in higher poverty rates. These, along with the added disadvantage of lower tax revenues, have a negative impact on local, state and federal fiscal positions. A reduction in unemployment is also likely to contribute to an overall reduction in the high poverty rate in the region, which currently is higher than the statewide rate.

Although the region is currently experiencing a boom due to higher worldwide iron ore demand, some experts in the area believe that this may be transitory. Long-term trends in unemployment in St. Louis or Itasca Counties indicate that there is greater potential for socioeconomic benefits from the development of a large industrial project like the Mesaba Energy Project, as compared to other areas of the State of Minnesota. In addition, new regional mining projects will need additional electric energy, and regional diversification from energy development in the Arrowhead Region is likely to be economically beneficial for the region and the State.

6.1.11 Effects on Land Based Economies

The IGCC Power Station will generally have neutral or positive effects on area land-based economies. Although portions of the West Range and East Range soils are classified as Prime Farmland, no agricultural activity has occurred at either site in recent history.

Timber harvesting is the primary land use that has impacted the Buffer Land and has influenced the composition and dynamics of the forest cover. Both clear cutting and selective harvesting of timber have occurred on tracts of land within the East Range Footprint and Buffer Land, resulting in a patchwork like pattern of cleared recently cut areas and stands of forest cover of varying ages and compositions. All of the East Range uplands are vegetated with northern mesic mixed forest – aspen birch forest (balsam fir subtype). In 2004 or 2005, a sizable portion of the site’s upland forest cover was cut for timber production. The remaining forest cover is relatively young, with those lands having been harvested within the past 25 years. There is no old growth forest cover within either the West Range or East Range Footprints or Buffer Lands.

Opportunities for harvesting timber will be investigated as part of the clearing of the sites, routes and utility and transportation corridors. The IGCC Power Station Footprint will take a relatively small acreage out of potential timber production, but Buffer Land is expected to be generally undisturbed.

Area tourism is not expected to be adversely impacted by the IGCC Power Station. The Hill-Annex State Park will benefit from the IGCC Power Station being operated at the West Range Site because the water levels in the Hill-Annex Mine Pit would be better managed in conjunction with the IGCC Power Station's water management plan. Also, once the Station is placed into commercial operation, it is expected to attract visitors from around the world given its deployment of state-of-the-art technology. The IGCC Power Station is also likely to attract future research and development investments relating to hydrogen, greenhouse gases, coal-to-liquids, and other synergistic industries.

The mining industry will not be adversely impacted by the IGCC Power Station. At the East Range, the IGCC Power Station may benefit the development of proposed mining projects in the area. The IGCC Power Station water needs may present an economical and environmentally preferred means for disposing of excess water generated from those proposed mining operations. Additionally, at some future date the IGCC Power Station could be the source of substitute natural gas as the taconite and other industries search for solutions to the high cost and declining availability of natural gas, a critical component to their production processes and cost structures.

6.2 ELECTRIC AND MAGNETIC FIELDS

High-voltage AC transmission lines produce extremely low frequency (60 hertz) alternating electric and magnetic fields. Electric fields are lines of force exerted on electrically charged particles. Electric fields are measured in units of volts/meter. Magnetic fields, on the other hand, are lines of force exerted on moving charged particles (current). Magnetic flux density is measured in units of gauss, or milligauss.

Magnetic fields are generally considered to have more potential for affecting human health than electric fields, in part because electric fields are more easily reduced by shielding. The intensity of the electric field is related to the voltage of the line. However, the intensity of the magnetic field is directly related to the amount of current flowing through the conductors, not the voltage. Therefore, a higher-voltage transmission line does not necessarily produce stronger magnetic fields than lower voltage lines. (See predicted fields data in Section 4.4, above).

6.2.1 Regulatory Limits

In the United States there are no federal standards limiting occupational or residential exposure to 60 Hz EMF. Six states have set standards limitations for electric fields (Florida, Minnesota, Montana, New Jersey, New York and Oregon), and two states (Florida and New York) have established standards for magnetic fields, as shown in Table 6.2-1

Table 6.2-1. State Transmission Line Standards and Guidelines

State	Electric Field		Magnetic Field	
	On ROW	Edge ROW	On ROW	Edge ROW
Florida	8 KV/m [a]	2 KV/m		150 mG[a] (max load)
	10 KV/m [b]			200 mG[b] (max load)
				250 mG[c] (max load)
Minnesota	8 KV/m			
Montana	7 kV/m	1 KV/m [e]		
New Jersey		3 KV/m		
New York	11.8 KVB/m	1.6 KV/m		200 mG (max load)
	11 KV/m [f]			
	7 KV/m [d]			
Oregon	9 KV/m			

a For lines of 69-230 KV b. For 500 KV lines c. For 500 KV lines in certain existing ROW
d. Maximum for highway crossings e. May be waived by the landowner f. Maximum for private road crossings

The applicable electric field maximum in Minnesota is 8 kV/m. Predicted electric fields at the centerline in the right-of-way for the proposed high-voltage transmission lines are shown in Section 4 (Tables 4.4-1 through 4.4-5). The predicted electric fields are all less than one-fifth the applicable regulatory maximum.

6.2.2 EMF Health Concerns

Some initial epidemiological studies of 60 Hz EMF levels showed a weak but possible correlation between magnetic fields and childhood leukemia. However, after over twenty years of research there is general scientific consensus that there is no evidence that power line EMF causes biological responses and adverse health effects in humans. Recent research indicates:

- There is little evidence that power lines are associated with an increase in cancer.
- Laboratory studies have shown little evidence of a link between power-frequency fields and cancer.
- An extensive series of studies have shown that life-time exposure of animals to power-frequency magnetic fields does not cause cancer.
- A connection between power line fields and cancer is physically implausible.

In 1999 the National Institute of Environmental Health Sciences (NIEHS) issued its final report on "Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields" in response to the 1992 Energy Policy Act. NIEHS concluded that the scientific evidence linking EMF exposures with health risks is weak and that this finding does not warrant aggressive regulatory concern.

In 2002, Minnesota formed an Interagency Working Group to evaluate the body of research and develop policy recommendations to protect the public health from any potential problems resulting from High Voltage Transmission Lines (HVTL) EMF effects. The Working Group consisted of staff from the Department of Health, the Department of Commerce, the Public Utilities Commission, the Pollution Control Agency, and the Environmental Quality Board. The Department of Health coordinated the activities of the Working Group. In September 2002, the Working Group published its findings in a White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options (White Paper). The following summarizes the findings of the Working Group:

> Research on the health effects of EMF has been carried out since the 1970's. Epidemiological studies have mixed results – some have shown no statistically significant association between exposure to EMF and health effects, some have shown a weak association. More recently, laboratory studies have failed to show such an association, or to establish a biological mechanism for how magnetic fields may cause cancer. A number of scientific panels convened by national and international health agencies and the United States Congress have reviewed the research carried out to date. Most concluded that there is insufficient evidence to prove an association between EMF and health effects; however many of them also concluded that there is insufficient evidence to prove that EMF exposure is safe. (EMF White Paper, 2002).

Similar conclusions were reached by the Public Service Commission of Wisconsin in its extensive review in the Arrowhead-Weston Electric Transmission Line Project EIS proceeding (October 10, 2000).

Despite this general consensus, however, there are still some concerns. For example, California's Department of Health Services (DHS) published a report by the California EMF Program in 2002 that concluded there was a weak but probably real association between EMF and cancer. The California panel reached this conclusion having reviewed the same information as other researchers, but using a decision-making approach that was radically different from that utilized elsewhere.

Also, on June 3, 2005, the British Medical Journal released a paper entitled "Childhood cancer in relation to distance from high voltage power lines in England and Wales: a case-control study" (Draper 2005). This paper contained findings from a study on childhood cancer carried out by Oxford University that analyzed and compared 33 years of data (from 1962 to 1995) on 29,000 children diagnosed with cancer. The study found slightly elevated rates of childhood leukemia in children whose residence at birth was close to power lines. Proponents of the EMF health connection have argued that the magnetic fields produced by the power lines are responsible for this correlation. However, the British study found elevated rates of childhood leukemia at distances out to 600 m from the lines. At such distances, the magnetic fields in homes due to power lines are negligible compared to existing background levels. Moreover, the authors of the study found no causal link between childhood leukemia and EMF, stating "we emphasize again the uncertainty about whether this statistical association represents a causal relation." In addition, the authors state "neither the association reported here nor previous findings relating to level of exposure to magnetic fields are supported by convincing laboratory data or any accepted biological mechanism."

There are many sources of more detailed information on the potential health effects of EMF. For example, the Minnesota Department of Heath maintains information on its web site: http://www.health.state.mn.us/divs/eh/radiation/emf/index.html. Another extensive site maintained by a University of Wisconsin Medical research faculty is found at: http://www.mcw.edu/gcrc/cop/powerlines-cancer-FAQ/toc.html#19N

6.2.3 Prudent Avoidance

Although researchers have found no mechanism for EMF to cause cancer and studies have not shown a consistent association between power lines and health impacts, it is difficult to conclusively state that there is no impact. Therefore, most regulatory agencies and other organizations have promoted a "prudent avoidance" policy. (See, e.g., Minnesota Working Group on EMF White Paper, 2002). The Minnesota Working Group White Paper concludes that passive regulatory action, such as providing public education and reducing magnetic fields when possible, is warranted.

6.2.4 Predicted Electric and Magnetic Fields

Predicted electric and magnetic fields for typical 345 kV and 345 kV/115 kV double circuit lines for this Project are described and shown in Section 4.4 above. The predicted EMF for the proposed double circuit 345 kV line on the West Range Site is also shown below in Figure 6.2-1. The predicted levels decrease rapidly away from the centerline, reaching approximately background levels of 2 mG (background) at 300 feet or less from the proposed transmission lines. Subject to final design, these predicted EMF levels reflect the mitigation designs described below.

6.2.5 Mitigation Measures

Consistent with the prudent avoidance policy described above, the Applicant has evaluated and will be implementing all reasonable mitigation methods to reduce EMF exposure. The three primary methods to be employed to reduce EMF are explained below.

Distance. The amount of EMF exposure is directly related to distance from the transmission line. The strength of both the electric and magnetic fields from transmission lines is inversely proportional to the square of the distance from the source conductors. Route options and designs have been selected in part to avoid residences to the extent possible. Also, the proposed right-of-way and structure heights for the HVTL lines have been designed to minimize EMF and to keep EMF exposure within appropriate ranges, as is shown in Figures 4.6-1 through 4.6-10. The Applicant will strive to route the transmission line the greatest distance practicable from residences and minimize impacts to farm outbuildings

Compaction. The configuration and distance between phases has an impact on EMF exposure. The amount of EMF exposure is reduced when the phases are compacted. A single circuit compacted triangular configuration has been adopted for both the West Range and the East Range to keep the EMF influence below the limits established by the EMF Standards.

Phase cancellation. Phase cancellation significantly reduces EMF from transmission lines. For the 230 kV double vertical circuit lines, the phase arrangement ABC-CBA reduces the magnetic field by approximately three times in comparison with an ABC-ABC arrangement as shown in Figure 6.2-2. The Phase I operation of the 345 kV double circuit phase arrangement can be adjusted in such a way to reduce the magnetic field by approximately 45%. The phase arrangement mitigation for the 345 kV line with 115 kV underbuild results in an approximate three-fold reduction in EMF relative to the unmitigated arrangement.

Figure 6.2-1 EMF Calculations for Double 345 kV Line

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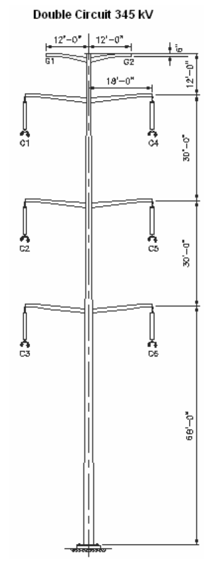
<td>
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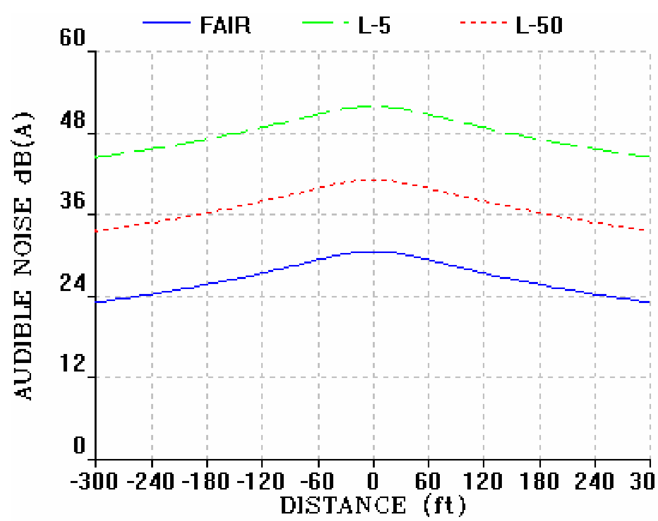
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<tr>
<td>Magnetic Field</td>
<td>Electric Field</td>
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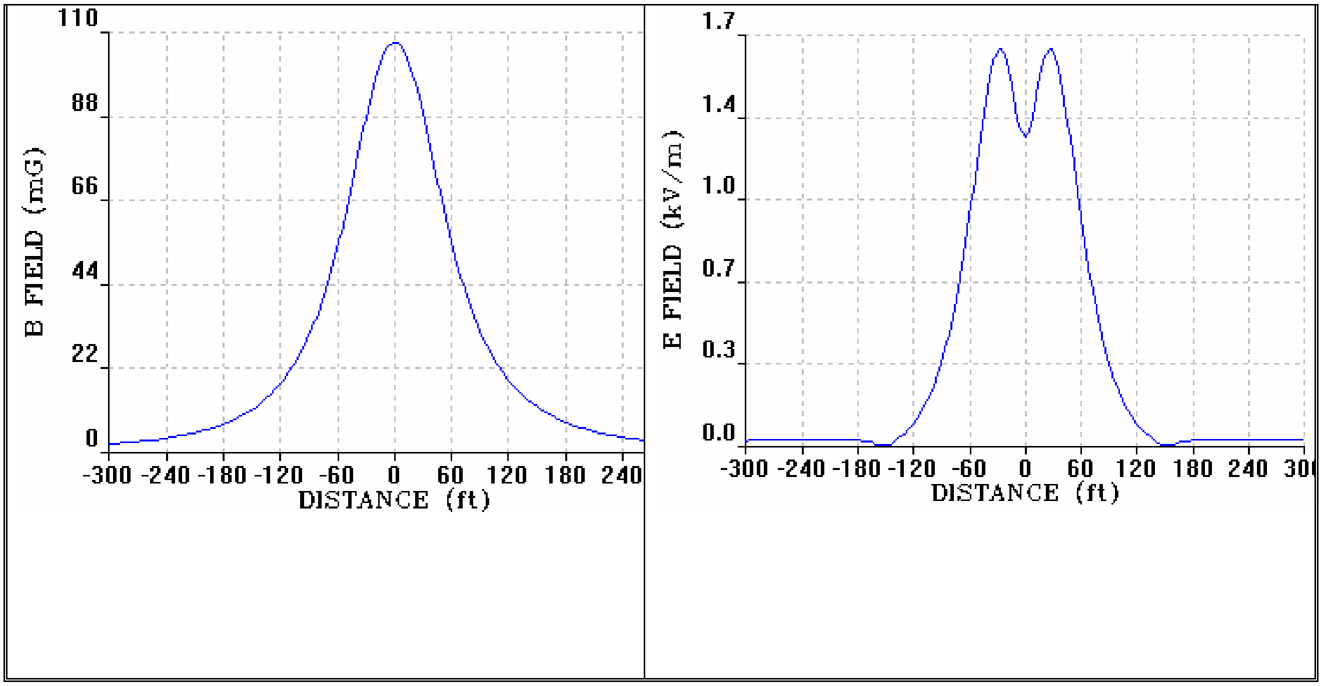
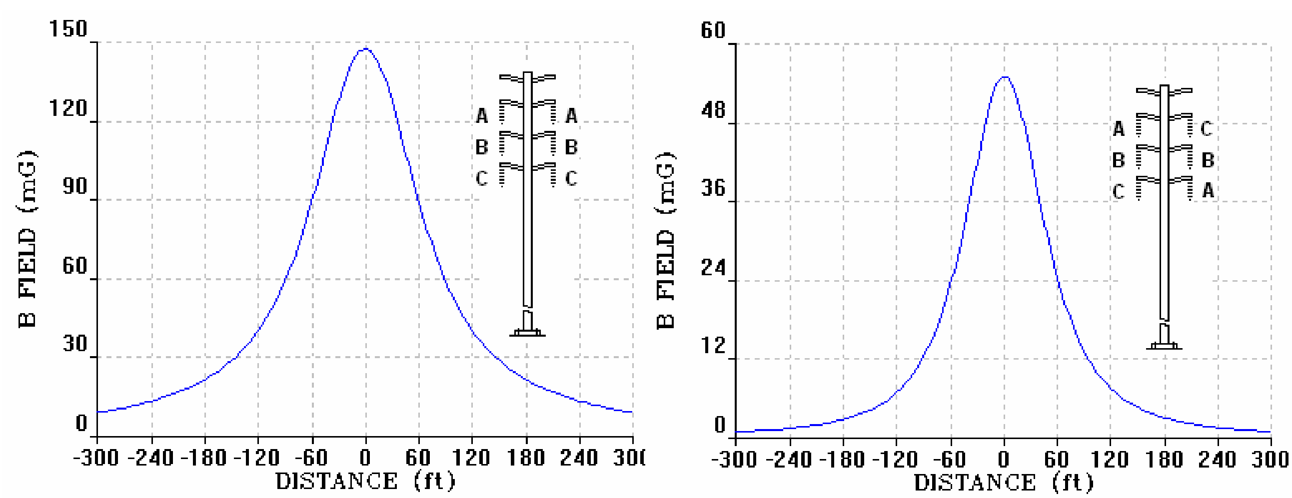


Figure 6.2-2 Phase Arrangement Comparison for 230 kV Line 2 CKT



For the 230 kV double vertical circuit lines with the 115 kV line underbuild, the phase arrangement ABC-CBA-ABC_{115} reduces the magnetic field by more than 2 times in comparison with the ABC-CBA-CBA_{115} arrangement as illustrated in Figure 6.2-3.

Figure 6.2-3 Phase Arrangement Comparison for 230 kV Line 2 CKT–115 kV Line Underbuild

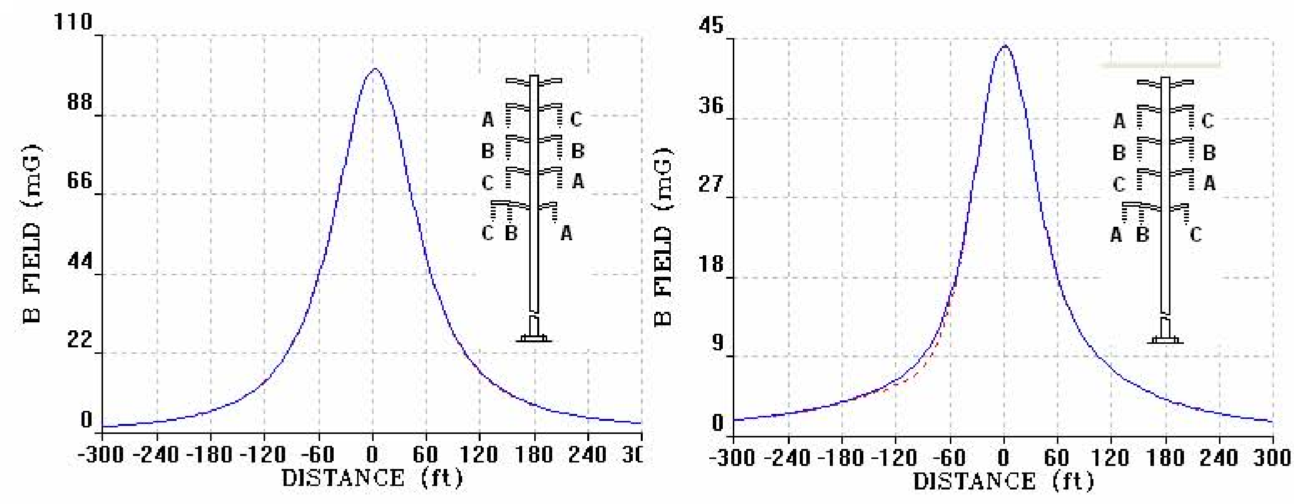
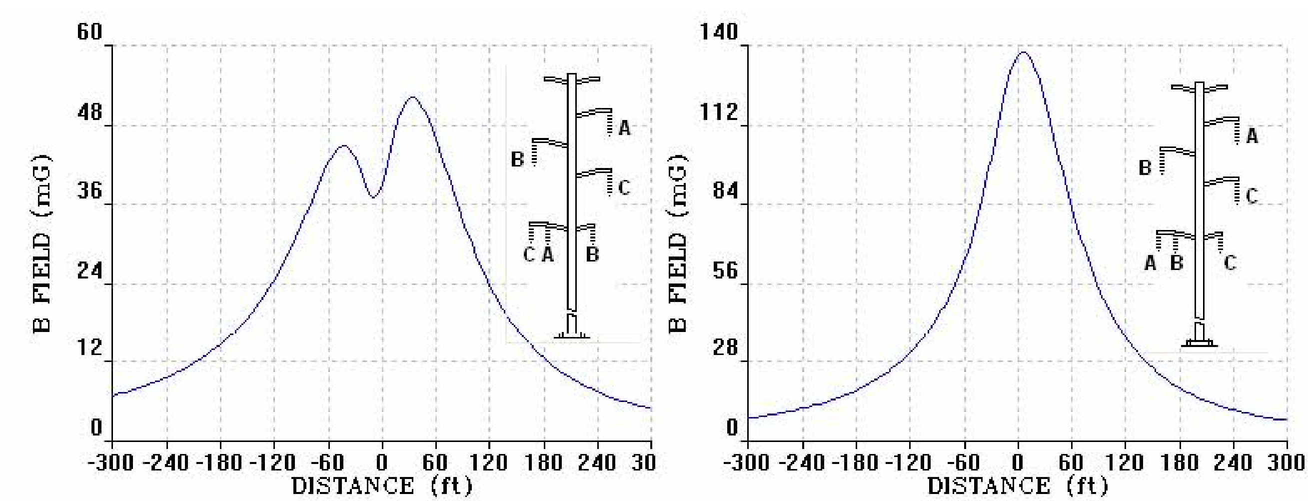


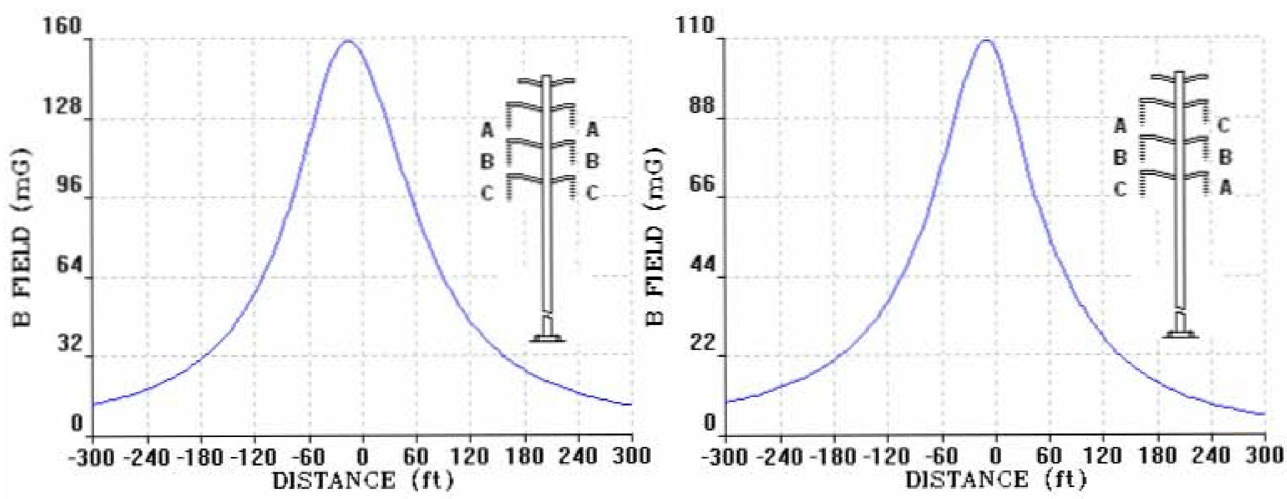
Figure 6.2-4 shows a reduction of the magnetic field by approximately 3 times when comparing the configuration ABC-CAB with the arrangement ABC-ABC of the 345 kV triangular structures with 115 kV circuit underbuild.

Figure 6.2-4 Phase Arrangement Comparison for 345 kV Line with 115 kV Underbuild



An approximately 45% reduction of the magnetic field can be achieved when the vertical phasing ABC-ABC is changed to the vertical arrangement ABC-CBA on the 345 kV line with parallel 115 kV line, as shown in Figure 6.2-5.

Figure 6.2-5 Phase Arrangement Comparison for 345 KV Line with Parallel 115 kV



6.2.6 Minimum Setback Requirements

New or renovated high-voltage transmission lines must comply with the most recently published edition of the National Electric Safety Code (NESC), as published by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), and approved by the American National Standards Institute (Minn. Stat. § 326.243 and Minn. R. 7826.0300, subp. 1).

The Applicant will comply with local, state, NESC, and other applicable utility standards regarding the installation of facilities, clearance to ground, clearance to crossing utilities, clearance to buildings, strength of materials, and ROW widths. The Applicant will use more conservative clearances than the NESC requirements in cases where it has determined the need for additional clearances to protect facilities from damage. Some clearances are mandated by the Minnesota Department of Transportation (Mn/DOT). A list of applicable standards are included for the 345 kV transmission is provided in Table 6.2-2 below.

Frequently asked questions about the NESC standards are available on the IEEE website at: http://standards.ieee.org/faqs/NESCFAQ.html.

Table 6.2-2
NESC Clearances for 345 kV Transmission Lines

Condition	NESC minimum clearance to conductor
Roads, streets, agricultural lands, forests traversed by vehicles	24’-9” (vertical)
Water areas not suitable for sail boating	23’-3” (vertical)
Water areas suitable for sail boating – 20 to 200 acres	39’-9” (vertical)
Water areas suitable for sail boating – 200 to 2000 acres	45’-9” (vertical)
Building roofs not accessible to pedestrians	18’-9” (vertical)
Building roofs accessible to pedestrians	19’-9” (vertical)
Building walls, projections, balconies	10’-9” (horizontal)
Grain Bin vertical clearance	18’ above highest fill point
Grain Bin horizontal clearance	Highest bin height + 18’
Tree vertical clearance	No specific requirement
Tree horizontal clearance	No specific requirement

7. WEST RANGE (PREFERRED) SITE ENVIRONMENTAL IMPACTS

Section 2.1 of this Application describes the general locations of both the preferred West Range Site and the alternate East Range Site. Section 2.5 provides a detailed description of the West Range Site. This section describes the potential impacts of Mesaba One and Mesaba Two on the natural environment at the West Range Site, including the impacts of the IGCC Power Station and its Associated Facilities, HVTLs, and natural gas pipelines.

The West Range Preferred and Alternate HVTL Routes are described in Section 2.5.3 and depicted in Figures 2.5-3 through 2.5-12. The routes for the West Range Proposed Natural Gas Pipeline are described in Section 2.5.4 and shown in Figures 2.4-16 through 2.4-20. Routes for the natural gas pipeline are shown in Figures 2.5-13 through 2.5-24.

Environmental impact information for the Alternative Site, the East Range Site, is summarized in Section 8. A more detailed description of the environmental setting for the West Range and East Range Sites is provided in Section 2 of the ES and an assessment of environmental impacts is presented in the ES at Section 3.

7.1 LAND USE IMPACTS

Land use impacts include those related to construction and operation of the IGCC Power Station, its Associated Facilities, the Interconnection Corridors, the Preferred and Alternate HVTL Routes, and the Proposed Natural Gas Pipeline Route. A detailed land use/land cover map showing the IGCC Power Station Footprint and Buffer Land is provided in Figure 7.1-1 and a regional-scale land use/land cover map showing the Proposed and Alternate HVTL Routes and the Proposed Natural Gas Pipeline Route is provided in Figure 7.1-2.

Predicted permanent and temporary land use impacts are presented in Tables 7.1-1 and 7.1-2, respectively for the IGCC Power Station, its Associated Facilities, the Additional Lands, HVTL routes, and natural gas pipeline routes. The temporary and permanent land use impacts for HVTL routes shown is the current land use in the existing right-of-way. Actual permanent impacts due to any of the HVTL routes relate primarily to the small (total less than 0.5 acre) area required for tower foundations, and the clearing of forested areas. Likewise, temporary impacts relate to the near-term impacts of construction in those areas of the Project, many of which are generally amendable to repair and remediation.

Section 2.8 of the ES provides a more detailed description of existing local and regional land use and the information sources related thereto. Section 3.7 of the ES provides a detailed analysis of the permanent and temporary impacts that will accompany development of the West Range Site. The following discussions summarize the information contained and presented in the ES.

Figure 7.1-1 Land Use and Land Cover in the Vicinity of the West Range Site

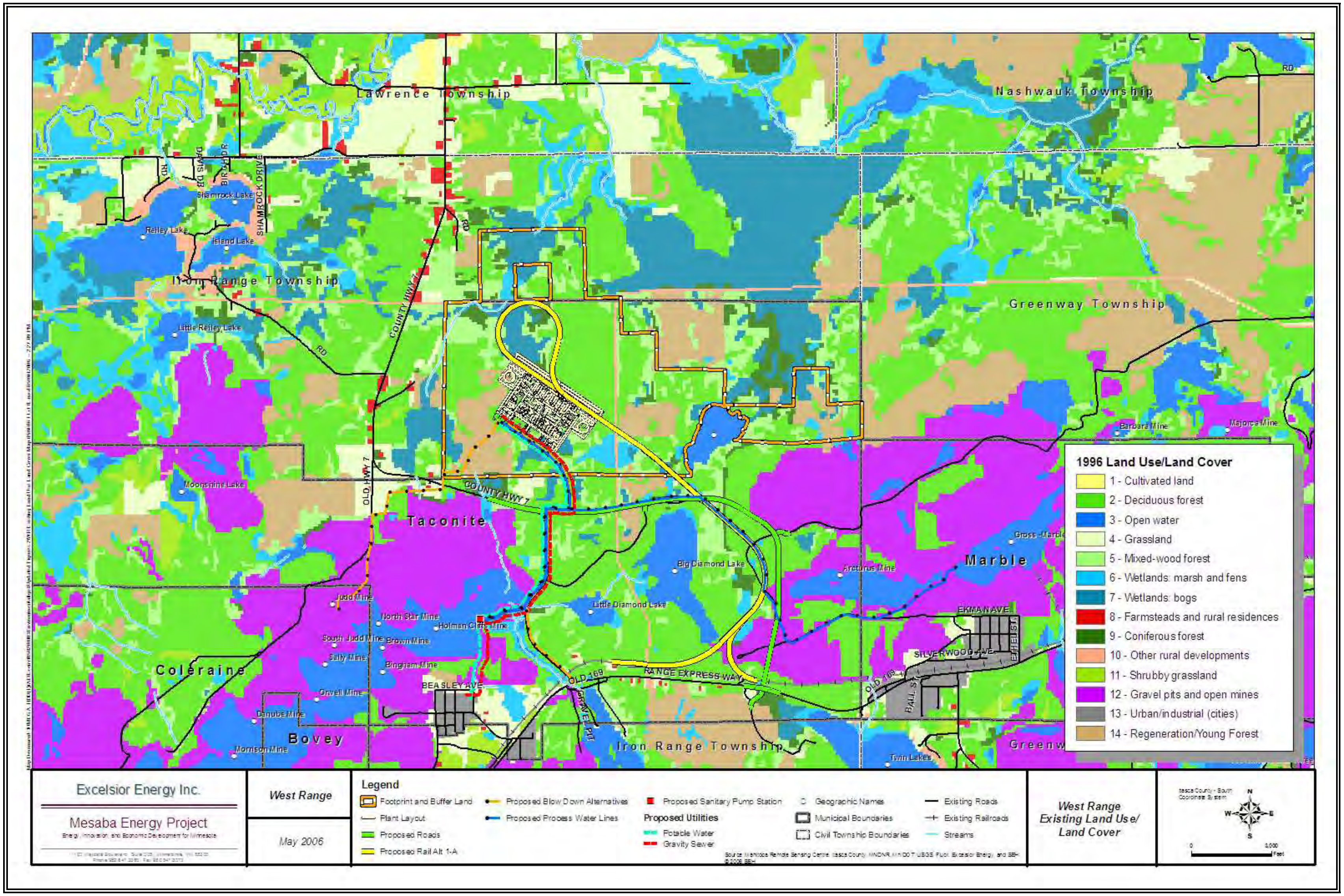


Figure 7.1-1 Land Use/Land Cover Map Showing the Preferred and Alternate HVTL Routes and Proposed Natural Gas Pipeline Route

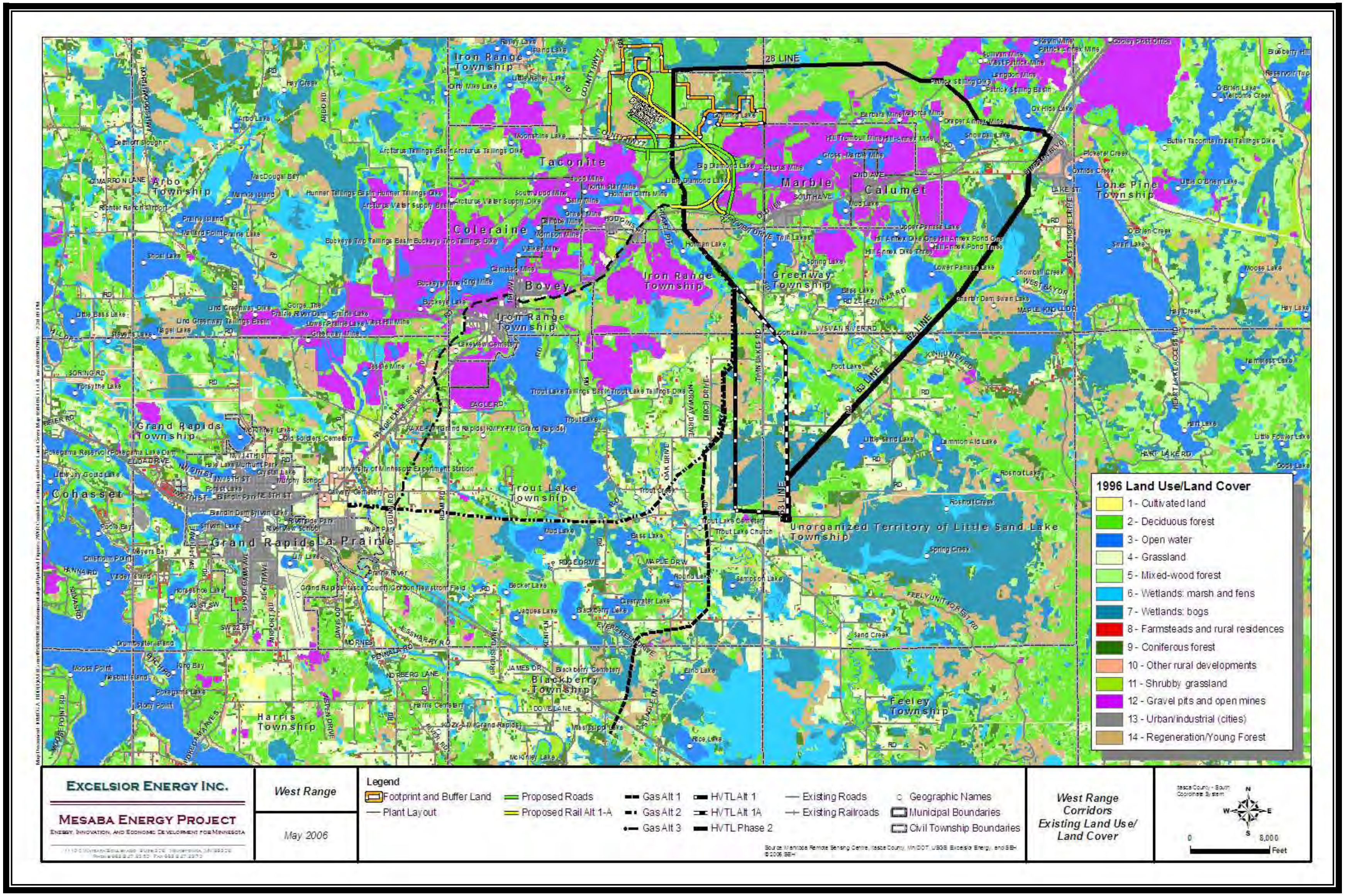


Table 7.1-1 - West Range Site Land Use Permanent Impacts (Acres)

						Process Water Lines			Process Water Blowdown Pipelines					
	West IGCC	**Preferred Route**	**Alternate Route**	**Plan B Alt. Route**	**Gas Pipeline**	**1**	**2**	**3**	**line 1**	**line 2**	**Potable**	**Rail 1**	**Rail 1B**	**Road 2**
Coniferous forest	4.3	8.0	5.5	0	8.1	0	0.1	2.0	0.2	0.2	0.0	2.1	3.6	0.26
Deciduous forest	86.5	41.3	40.1	0	21.1	1.7	12	25.0	18.1	4.0	5.3	32.8	38.8	6.6
Farmsteads and rural residences	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0
Grassland	0.0	2.8	12.2	0	14.2	0	0	0	0	6.1	0.6	0.6		0.0
Gravel Pits & Mines	0	0	1.1	0	0	24.5	4.0	21.9	2.4	9.9	4.0	2.4	7.1	0.0
Mixed wood forest	56.2	12.7	9.4	0	17.8	0	4.9	5.7	6.2	0.8	1.8	17.7	11.9	4.0
Open water	0.0	0.8	2.3	0	0.4	0.4	0	0.8	0	0	0	0.3	0	0.0
Other rural	0.0	8.7	5.6	0	12.7	0	0.0	0.2		5.3	0.1	2.0	0.5	0.0
Regeneration/Young Forests	3.1	26.4	15.4	0	16.2	0	0.2	1.6	0.1		0.1	0.3	0.2	0.14
Surveyed Wetlands	30.9	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
Shrubby grassland	0.0	4.4	1.8	0	7.4	0	2.9	0.1	0	0	0	0	0	0.0
Wetlands - bogs	4.6	24.8	19.9	0	10.2	0	0.2	1.4	2.6		1.2	6.2	7.8	3
Wetlands - marsh and fens	0.0	4.3	7.2	0	3.6	0	0	0	0	0	0.1	4.7	5.2	0.0
Total	**185.6**	**134.1**	**120.5**	**0**	**111.7**	**26.6**	**24.7**	**58.7**	**29.6**	**26.3**	**13.3**	**69.0**	**75.1**	**13.9**

Table 7.1-2 West Range Site Land Use Temporary Impacts (Acres)

						Process Water Lines			Process Water Blowdown Pipelines					
	West IGCC[1]	Preferred HVTL	Alternative HVTL	Plan B Alt HVTL R.	Gas Pipeline	1	2	3	line 1	line 2	Potable H2O	Rail 1	Rail 1B	Road 2
Coniferous forest	52.5	8.0	5.5	9.4	11.5	0	.1	2.5	0.4	.34	.1	5.1	5.4	0.4
Deciduous forest	694	41.3	40.1	68	31.2	2.6	18.5	37.3	27.0	6.1	13.5	69.1	99.8	11.2
Farmsteads	0.0	0.0	0	0.5	0	0	0	0	0	0.1	0	0	0	0
Grassland	1.6	2.8	12.2	67.1	20.3	0	0	0	0	8.8	1.8	.5	0	0
Gravel Pits and open mines	0.0	0.0	1.1	1.5	0	36.6	6.0	32.5	3.5	14.9	9.6	4.1	28.7	0
Mixed wood forest	326	12.7	9.4	28	25.8	0	7.5	9.1	9.6	1.15	4.8	33.2	24.7	6.4
NWI Wetlands	80.8	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0
Open water	2.8	0.8	2.3	1.2	.6	.74		1.6	0	0	0	.7		0
Other rural dev.	21.9	8.7	5.6	174	16.6	0	0	.34	0	0	0	3.6	1.5	0
Regeneration/Young Forests	221	26.4	15.4	22.7	23.2	0	.3	2.3	0.2	8.0	.2	.6	1.9	.25
Surveyed Wetlands	257	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0
Shrubby grassland	0.0	4.4	1.8	.6	10.5	0	0	0	0	0	0	0	0	0
Urban	0	0	0	4.9	0	0	0	0	0	0	.48	0	0	0
Wetlands - bogs	34.6	24.8	19.9	40.4	14.6	0	4.2	.13	3.8	0	2.81	15.8	11.5	4.88
Wetlands - marsh and fens	14.4	4.3	7.2	18.1	5.1	0	0.4	2.4	0	0	.43	6.4	6.3	0
Total	**1708**	**134**	**121**	**436**	**159**	**40.0**	**37.1**	**88.1**	**44.5**	**39.5**	**33.7**	**139**	**179**	**23.1**

7.1.1 Historical Overview

About 71% of the land area of Itasca County is forested with about 20% consisting of organic soils (USDA, 1987). An abundance of “wetland” areas exists throughout the region. Before extensive settlement, vegetation in the area was predominantly conifer/hardwood forest (Sims and Morey, 1972). Early settlement began in the 1860’s with settlers who came to harvest timber. Mining (iron ore) exploration began in the 1880’s. Some farming commenced in the late 1800’s, and by 1920 roughly ten percent of the land was farmed. Past and present mining activity in the area is shown in Figure 7.1-3, which also identifies the locations and extent of mine pits, waste-rock dumps and tailing basins in the vicinity of the West Range Site.

7.1.2 IGCC Power Station Power Station Footprint and Buffer Land

The land use/land cover map provided in Figure 7.1-1 shows that land cover within the IGCC Power Station Footprint and Buffer Land is mostly forested, consisting of coniferous forest, mixed wood forest and regeneration/young forest. Wetlands located within the Station Footprint and Buffer Land represent about 20 percent of the total land area, remarkably consistent with the overall content of organic soils in Itasca County. The land use/land cover map shows a land use category within the Buffer Land labeled as “other rural developments.” In this instance, this category represents land used as ROW for existing HVTLs.

Within the Station Footprint forests represent approximately 85-90 percent of the land area, with the remaining area being wetlands. Figure 7.1-4 shows a detailed view of the Station Footprint and identifies the geographical distribution of forest types.

Permanent land use impacts across the entire Station Footprint will occur due to the clearing and grading required to accommodate Mesaba One and Mesaba Two, and to provide acceptable grades for unit coal trains to access the Power Station. A cut through till, coarse alluvium, and bedrock will be required for the railroad alignment (such alignment being oriented in a north-west, south-east direction) located generally adjacent to and east of the Station Footprint. The plant area will require similar cuts and fills in several other locations. Figures 3.2-3 and 3.2-4 in Section 3.2 show the preliminary grading plan prepared for the IGCC Power Station.

Soil conditions on the Station Footprint and the Buffer Land affecting constructability are shown in Figure 7.1-5. The presence of peat and muck, low strength and highly compressible soil types, will cause settlement issues unless properly managed. Along the north end of the rail loop filling will be required.

Approximately 160 acres of forested land and 31 acres of wetlands (out of a total of about 185 acres total) will be cleared and utilized to accommodate the Station Footprint. Topsoil will be stockpiled for later use after clearing and grubbing this area.

Figure 7.1-2 Mining Disturbances in the Vicinity of the West Range Site

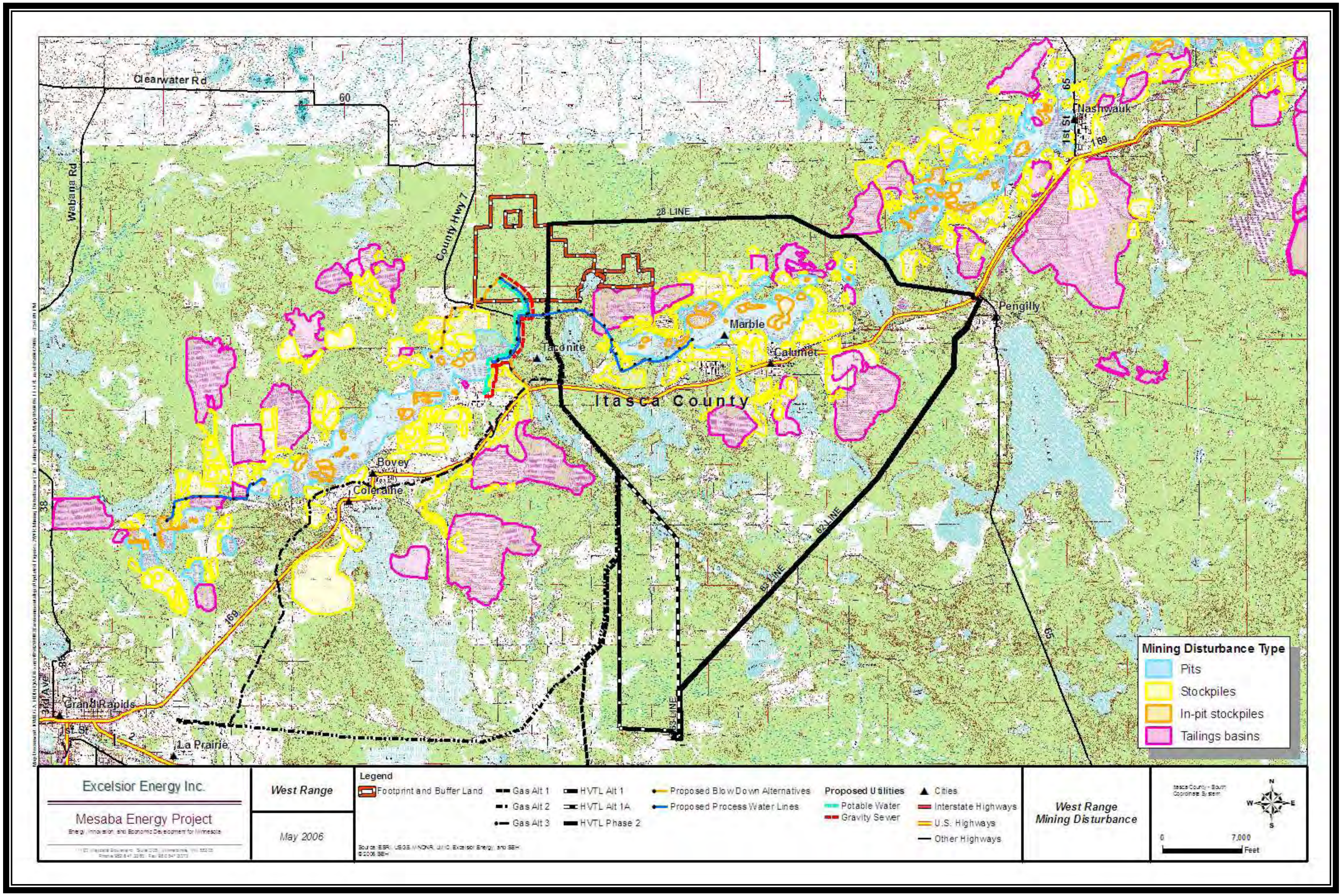
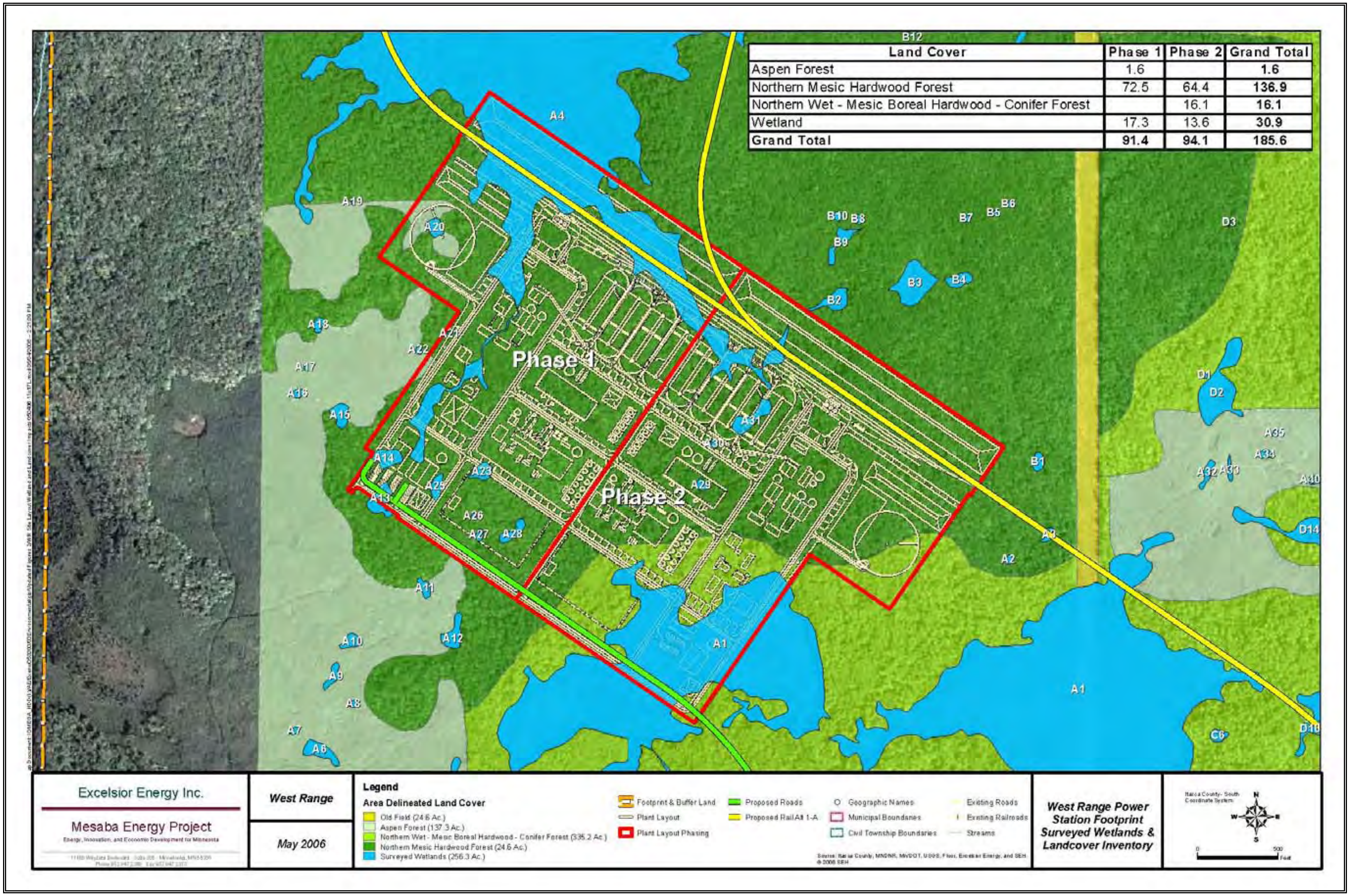
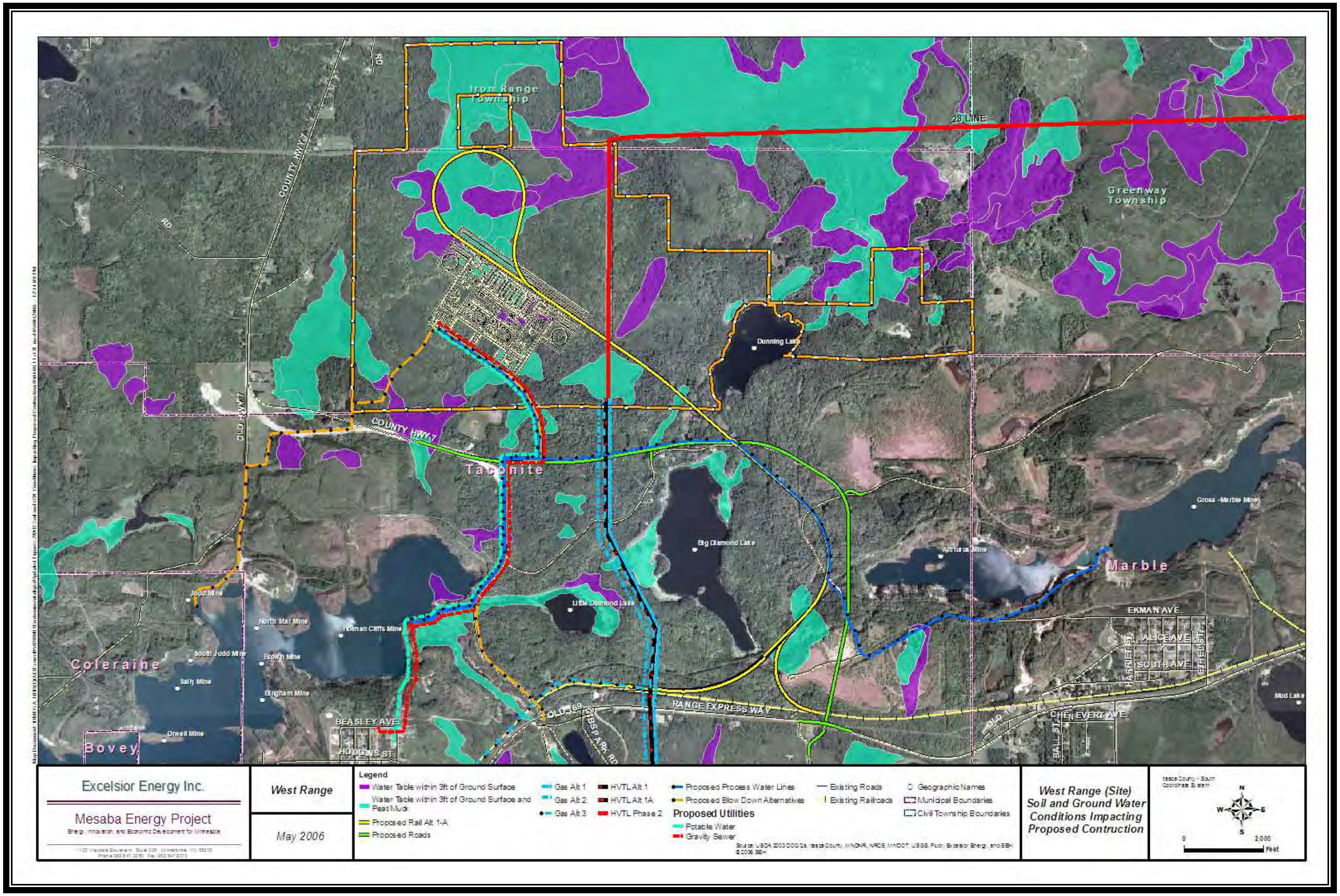


Figure 7.1-3 Distribution of Forested Areas and Wetlands Across the IGCC Power Station Footprint



Land Cover	Phase 1	Phase 2	Grand Total
Aspen Forest	1.6		1.6
Northern Mesic Hardwood Forest	72.5	64.4	136.9
Northern Wet - Mesic Boreal Hardwood - Conifer Forest		16.1	16.1
Wetland	17.3	13.6	30.9
Grand Total	91.4	94.1	185.6

Figure 7.1-4 Difficult Soil Conditions Occurring Within the Station Footprint and Buffer Land That Affect Construction



7.1.3 West Range HVTL Routes

The West Range Preferred and Alternate HVTL Routes are described in Section 2.5.3 and are illustrated with mileposts markings in Figure 2.5-3 through Figure 2.5-12. A milepost map superimposed on a USGS map is provided for the Preferred HVTL Route in Figures 2.2-1 through 2.2-4. The design of the HVTL structures that will be used in each route and the ROW required to accommodate such structures are described in Section 4.

Three West Range HVTL routing options are proposed for consideration. For ease of reference the three proposed routes will be described in this Application as the "Preferred," "Alternate" and "Plan B Phase II Alternate" Routes, respectively.

7.1.3.1 Preferred Route

Land cover within the Preferred HVTL Route is predominately forest. The total length of the route is 8.7 miles. The ROW width required is 150 feet when it is shared with the gas line route and 100 feet without inclusion of the pipeline ROW. Approximately 88 acres, or 66 percent, of the Preferred HVTL Route is forest land. Wetlands comprise approximately 29 acres of the route. The 88 acres of forest land will be permanently cleared to prepare the ROW for HVTL construction. Minimal grading is expected along the route. Between the IGCC Power Station Footprint and the retired Greenway Substation, existing transmission towers will be removed and replaced with new steel transmission towers that will accommodate the proposed new single-pole double circuit 345kV HVTL lines. These towers are typically constructed at existing grade and are supported on drilled shaft foundations. Disturbance of soils is expected to be limited to localized areas around transmission towers and wheel paths for the construction equipment. Trees in the ROW will have to be cleared, but some vegetation will be reestablished once construction is complete.

7.1.3.2 West Range Alternate HVTL Route

The alternate route is described in Section 2.5.3. The ROW width required for the double circuit line is 150 feet when it is shared with the gas line route, 100 feet when alone. Minimal grading is expected in the route, but clearing of trees and other vegetation will be required. Because the Alternate HVTL Route shares some ROW with a roadway, it will require less tree clearing than the Preferred HVTL Route. Approximately 70 acres of forest land would be cleared to construct the Alternate Preferred HVTL Route, with the line crossing twenty-six acres of wetlands. As for all HVTL routes, erosion control practices will be employed during construction. Following construction, vegetation will be re-established along the route to prevent erosion and migration of sediment.

7.1.3.3 Plan B Phase II Alternate Route

This alternate HVTL route consists of approximately 18 miles of new 345-kV line constructed as a "double circuit" on the existing 115 kV HVTL ROW, with the 115kV circuit being moved to the 345 kV structures. Therefore, no further permanent impacts on land use are expected. The new HVTL towers will be taller than the existing structures and, therefore, may have some minimal additional visual and aesthetic impact.

7.1.4 Proposed Natural Gas Pipeline Route

The length of the Proposed Natural Gas Pipeline Route is approximately 13.2 miles. This Route will require a 100-foot ROW for construction activities and a 70-foot permanent ROW for maintenance. Grasslands comprise approximately 30 acres or 19 percent of the route. The route is described in detail in Section 2 and is illustrated relative to significant receptors in Figures 2.4-16 through 2.4-19.

Detailed descriptions of pipeline construction methods and right-of-way requirements are provided in Section 5 of this Application. Minimal grading is expected along the Proposed Natural Gas Pipeline Route. The gas pipeline will be installed either by open cut trenching or by directional drilling. Pipe installation methods will be further evaluated after a geotechnical investigation has been performed in the Proposed Natural Gas Pipeline Route. Approximately 91 acres of forested land will be cleared in creating the pipeline route. Of this, 63 acres will be permanently impacted, with 28 acres reverting back to original condition.

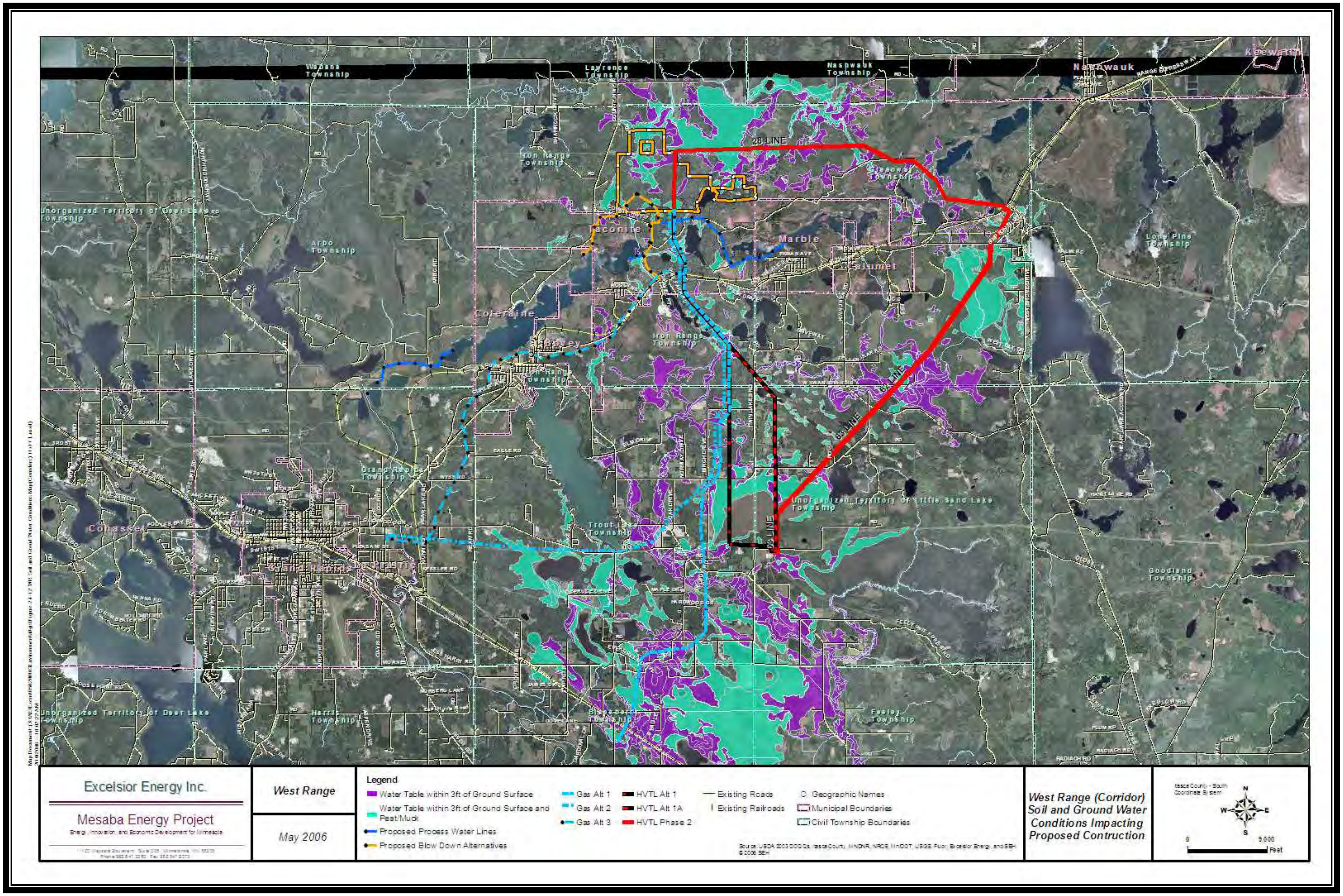
Figure 7.1-6 shows the locations of peat along the route as identified on the Itasca County Soil Survey. Peat is highly compressible and does not support heavy construction equipment. Construction during the winter months will alleviate the difficulty of construction in peat areas. If winter construction is not possible, crane mats and/or low ground pressure equipment `will likely be used.

Soils along the Pipeline Route are believed to be suitable for directional drilling. Directional drilling can maneuver around most boulders if any are encountered within the glacial till. If further geotechnical investigation encounters areas where bedrock is at or above the proposed pipe elevation, special directional drilling will be performed or, alternatively, open trench excavation with blasting will be performed.

If the Proposed Natural Gas Pipeline Route is installed by open cut trenching, trees and other vegetation will be cleared along the entire route. Cleared vegetation will be re-established once construction is complete. This vegetation would consist of grasses or wetland plants as appropriate. Trees will not be planted within the route to accommodate the need for permanent access for future repairs or improvements. The glacial till and lacustrine soils present are generally suitable for excavations for pipe construction. However, in areas where the ground water table is above the depth at which the pipe will be buried, the pipe will need to be designed for buoyant forces. Trench dewatering may be necessary to construct the pipeline.

The glacial outwash is generally suitable for trench excavation, but boulders and cobbles in the till could impede such excavations. Trench excavation in peat will be more difficult since the ground water table is shallow and the soils have low strength. The pipe installed in the peat must also be designed for buoyant forces.

Figure 7.1-5 Soil and Groundwater Conditions Impacting Construction Along HVTL and Natural Gas Pipeline Routes



7.1.5 Process Water Supply Pipeline

At the West Range Site, water will be supplied from three sources, all of which require water supply pipelines. The water supply plan is described in Section 4, and the Process Water Supply Pipeline alignments are shown in Figure 7.1-7.

7.1.5.1 Segment 1 - Lind Pit to Canisteo Pit

The West Range Process Water Supply Pipeline Segment 1 will require a 100-foot permanent ROW and a 150-foot temporary ROW.

Land use within the West Range Process Water Supply Pipeline Segment 1 corridor is classified as predominately inactive gravel pits and former mines. The length of the corridor is 2.2 miles and requires use of about 24 acres of land that will be permanently impacted. Thirteen acres of the ROW land will be allowed to revert back to original condition.

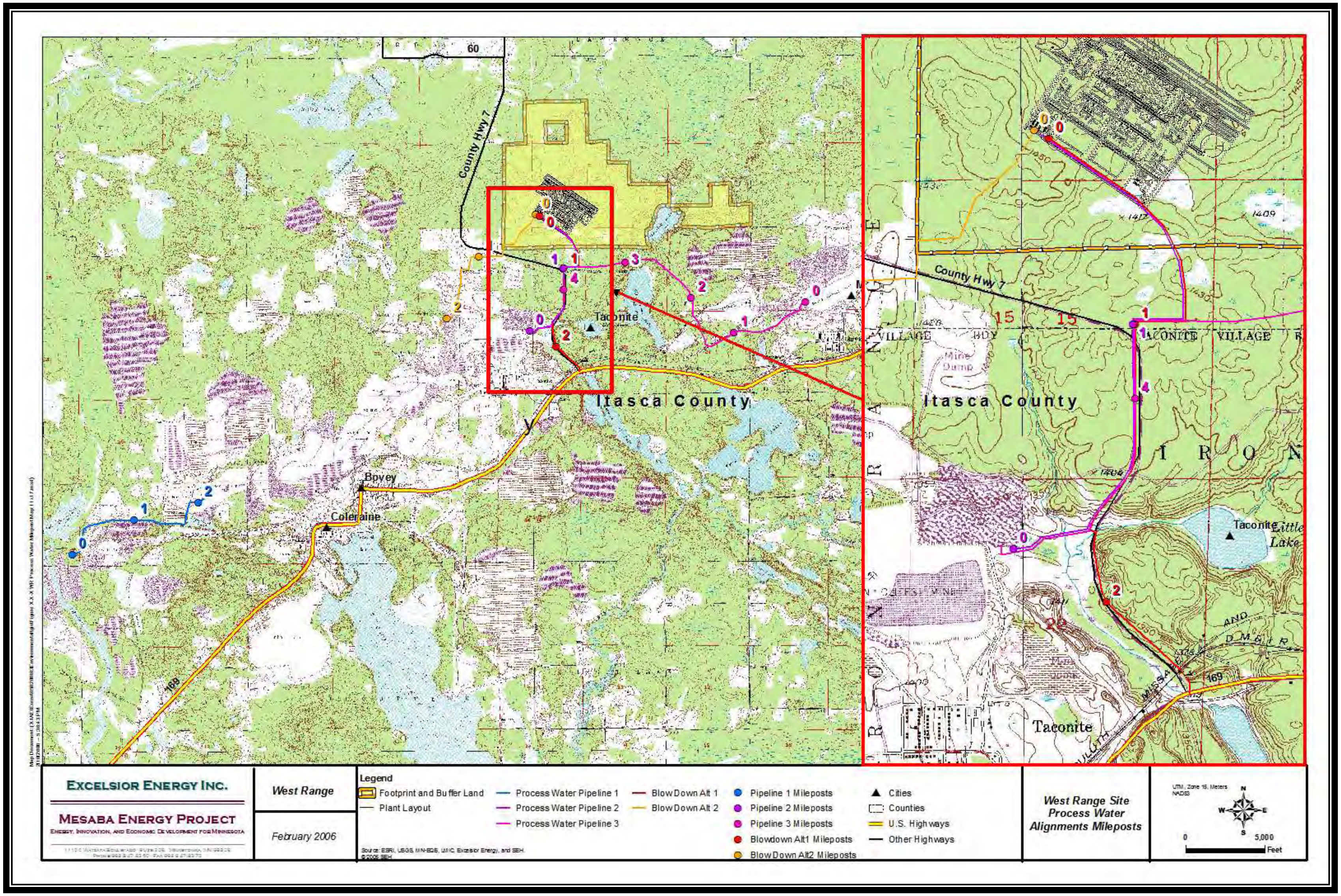
7.1.5.2 Segment 2 - Canisteo Pit to West Range Site

Land use within the West Range Process Water Supply Pipeline Segment 2 corridor is predominately forest land. The length of the corridor is approximately 2.0 miles. Approximately 26 acres of forest land must be cleared to build the Segment 2 corridor, with 18 acres of permanent impact and 8 acres reverting back to original condition.

7.1.5.3 Segment 3 - Gross-Marble Pit to Canisteo Pit

Land within the Process Water Supply Pipeline Segment 3 corridor contains approximately 51 acres of forest land. Approximately 32 acres or 37 percent is inactive gravel pits and open mines. The length of the corridor is 4.8 miles. 51 acres of forest land will be cleared to construct the Segment 3 corridor, resulting in about 34 acres of permanent impact. The remaining 17 acres will be allowed to revert back to original condition. Approximately 32 acres of gravel pits and open mines will be impacted to build Segment 3, resulting in about 22 acres of permanent impact.

Figure 7.1-6 Process Water Supply Pipeline and Process Water Blowdown Pipeline Alignment Milepost Map



7.1.6 Process Water Blowdown Pipelines

Process Water Blowdown Pipeline alignments are shown in Figure 7.1-7 along with the Process Water Supply Pipelines.

7.1.6.1 Process Water Blowdown Pipeline 1

The length of the Process Water Blowdown Pipeline 1 corridor is 2.43 miles. Land use within the corridor is predominately forested with approximately 37 acres of forest land needed to be cleared to for the Process Water Blowdown Pipeline 1 corridor, resulting in about 25 acres of permanent impact. The remaining 12 acres will be allowed to revert back to original condition.

7.1.6.2 Process Water Blowdown Pipeline 2

The length of the Process Water Blowdown Pipeline 2 corridor is 2.16 miles. Land use within the Process Water Blowdown Pipeline 2 corridor is predominately inactive gravel pits and open mines. Sixteen acres of forest land will be cleared to build the Pipeline 2 corridor, resulting in about 10 acres of permanent impact. The remaining 6 acres will be allowed to revert back to original condition. Approximately 15 acres of gravel pits and open mines will be impacted resulting in about 9 acres of permanent impact. The remaining 6 acres will be allowed to revert back to original condition.

7.1.7 Potable Water and Sewer Pipelines

Potable Water and Sewer Pipeline will be installed parallel to each other within the same corridor. Existing land use within the corridor is predominately forest consisting of approximately 19 acres. Gravel pits and open mines comprise 10 acres or 29 percent of the corridor. The Potable Water and Sewer pipelines will be located on a new corridor from the plant to existing CR 7. The pipeline will follow the existing CR 7 alignment for a distance of 3,300 feet, turning west for 1,600 feet to the CMP, then south 2,600 feet to the City of Taconite. Trees and other vegetation will be cleared along the corridor. Where the corridor follows CR 7, portions of a trench could partially overlap the highway, requiring traffic to be diverted around the area of impact. If the pipeline is constructed using a trenchless method such as microtunneling, the highway could remain open to traffic. The Applicant will discuss such construction methods with Itasca County prior to commencement of construction. Native vegetation and the roadway surface will be re-established after construction. Trees will not be planted in the utility corridor to allow for future maintenance or repairs. In areas where CR 7 is disturbed, it will be restored to at or near the condition (pavement section, subgrade, etc.) it was prior to construction. Where the pipeline is constructed on City of Taconite street right-of-way, streets will be reconstructed to at or near the condition (pavement thickness, subgrade, curb, etc.) that existed prior to construction of the water and sewer pipeline.

The Process Water and Sewer Pipeline will require a 40-foot permanent ROW and a 100-foot temporary ROW. Approximately 19 acres of forest land will be cleared for the pipeline corridor, resulting in about 7 acres of permanent impact. The remaining 12 acres will revert back to original condition.

7.1.8 Rail Lines

7.1.8.1 Preferred Rail Line Alternative 1 A

Land use within the Rail Line Alternative 1A corridor is predominately forested, containing approximately 108 acres of forested land. Wetlands comprise 16 percent. A cut through till, coarse alluvium, and bedrock will be required for Rail Line Alternative 1A. Along the north end of the rail loop extensive filling will be required, with some occurring over organic soils. Boulders will be somewhat problematic for construction and are not considered suitable fill except where blended into the fill for large embankments associated with the railroad grade. The boulders may also be segregated and processed. Granite bedrock, once removed and processed, is considered to be a suitable construction material. The peat and muck encountered are not considered good construction materials, but may be used for construction of new wetlands.

Bedrock along the Rail Line Alternative 1A corridor consists of Giant’s Range Granite, Pokegama Quartzite, and the Biwabik Formation. The profile of Rail Line Alternaive 1A shows cuts of 30 to 78 feet below grade from the crossing with proposed CR 7 to the southeast end of the rail line. These excavations into bedrock will likely require blasting or tunneling. Rock bolting and anchors may be required to stabilize some slopes in the bedrock. Rail Line Alternative 1A will require a 100-foot permanent ROW and a 80 to 450-foot temporary ROW. Approximately 108 acres of forest land will be cleared for the Alternative 1A corridor, resulting in about 53 acres of permanent impact. Fifty-five acres will revert back to original condition.

7.1.8.2 Alternate Rail Line Alternative 1 B

Land use within the Rail Line Alternative 1B corridor is predominately forested, representing 132 acres of the rail line corridor. Gravel pits and open mines comprise the remaining 29 acres. Eighteen acres of wetlands also exist within the corridor. Alternative 1B will require a 100-foot permanent ROW and a 60- to 760-foot temporary ROW. Approximately 132 acres of forest land would be cleared to build the Rail Line Alternative 1B corridor, resulting in about 54 acres of permanent impact. Seventy-eight acres would revert back to original condition.

7.1.9 Access Roads

The West Range Site requires two new access roads. Itasca County will own Access Road 1. The Applicant will own Access Road 2. Both roads will require a 120-foot permanent ROW and a 200-foot temporary ROW.

7.1.9.1 Access Road 1

Itasca County intends to realign CR 7 to provide a better safety and traffic flow in the region, and to accommodate the construction and operation of the IGCC Power Station and a steel manufacturing facility to be located nearby. The County will assume responsibility for licensing, construction and maintenance of this realignment. Soil borings taken to gauge potential issues associated with construction in the area of the IGCC Power Station Footprint and Buffer Land, and the cross sections used in evaluating such issues, are shown in Figures 7.1-9 through 7.1-12.

7.1.9.2 Access Road 2

Access Road 2 will intersect the realigned County Road 7 at about elevation 1,425 feet above msl and descend to the plant site at about elevation 1,400 feet above msl. The ground surface along the route varies from about elevation 1,420 feet above msl to elevation 1,435 feet above msl, requiring the majority of the road to be in a cut section. The road traverses across Greenwood peat and Nashwauk fine sandy loam (glacial till). The areas constructed through peat will require either removal of the peat or soil improvement in the form of surcharging, staged loading wick drains, embankment reinforcement, or a combination of these methods.

The road cut will extend through the till at boring WR-5 and into coarse alluvium (gravel with silt and sand). The water table in WR-5 was at elevation 1,415 feet above msl, thus requiring that the road cut extend vertically through the water table in the area. It will be necessary to install subsurface drains to keep the road subgrade dry. By the time the entrance road reaches WR-8 it may be in a rock cut. Boring WR-8 was obstructed twice at about elevation 1,425 above msl and it is likely that the top of the bedrock exists at this elevation.

Figure 2.1-3 in Section 2 above shows the two roads that will be used to access the IGCC Power Station Footprint. Land use within the Access Road 1 and Access Road 2 corridors is predominately deciduous forest containing about 60 acres of forest land. Gravel pits and open mines comprise 23 acres of the road corridors. Excavations as much as 53 feet deep and embankments as high as 56 feet will be required to achieve the required grades for the Access Road 1 and Access Road 2 alignments. Trees and other vegetation will be cleared along the roadway corridor. Vegetation consisting of native grasses or native herbaceous plants will be re-established on embankments and cut slopes where appropriate. Trees will not be re-planted within the clear zone of the roadway and underground utility rights-of-way. Care will be taken in the design of project features to minimize damage to facilities due to frost action in the natural till or embankments constructed from till. Approximately 87 acres of forest land will be cleared to build the west range road corridors, resulting in about 52 acres of permanent impact. Thirty-five acres will be allowed to revert to original condition.

Figure 7.1-7 Soil Borings Useful in Determining Cut and Fill Required for Access Road 2

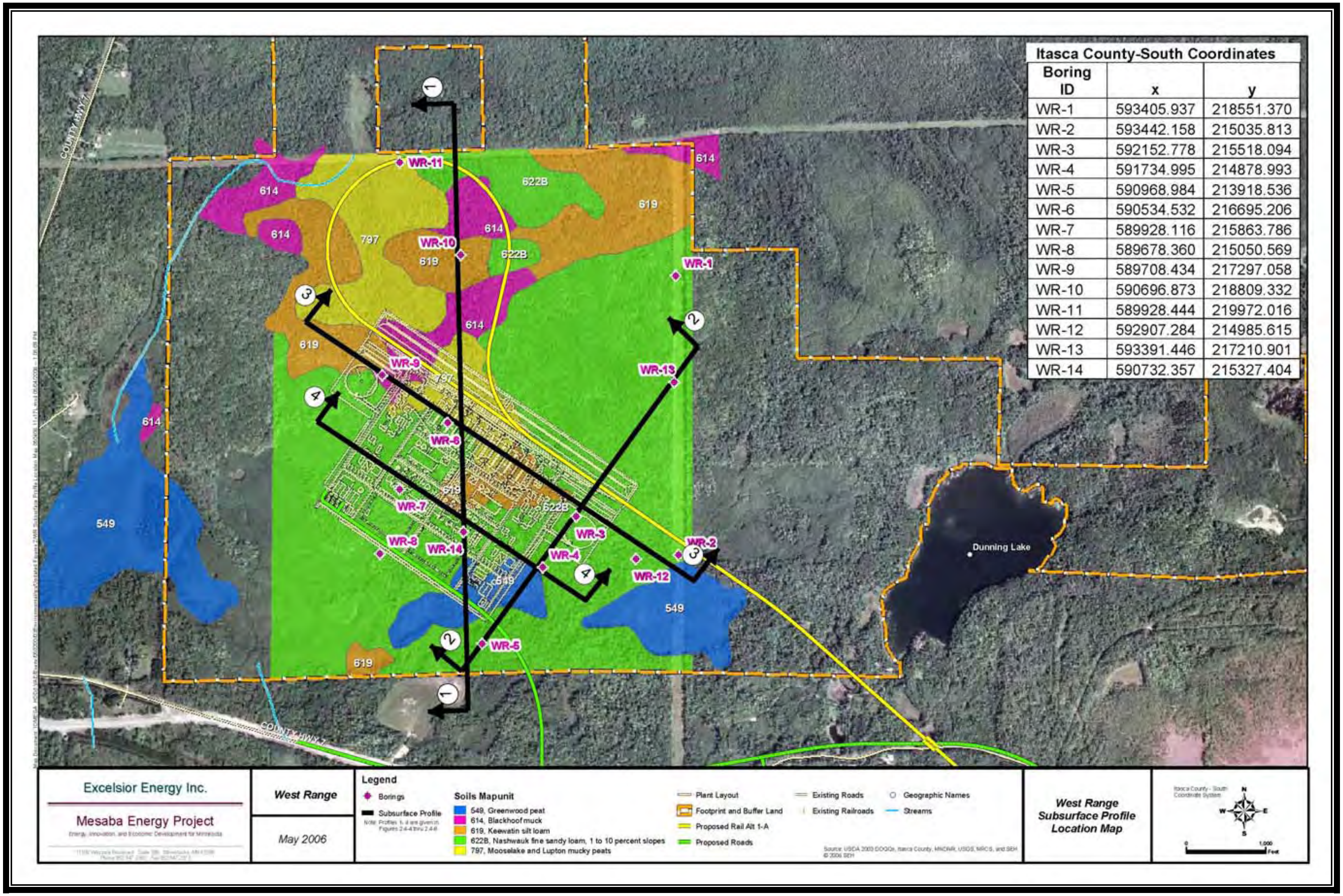
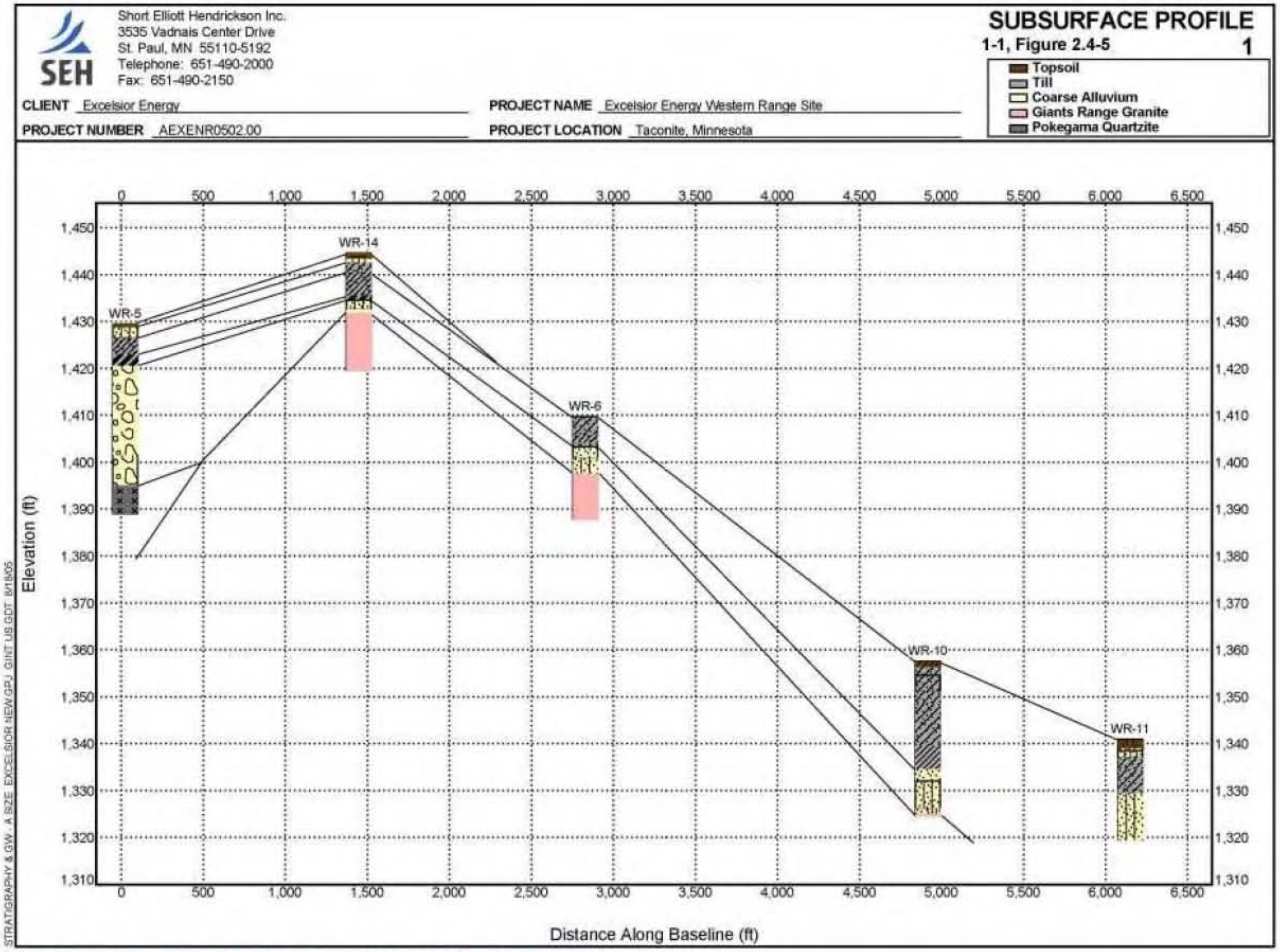


Figure 7.1-8 Subsurface Profile of Cross Section "1-1"



Topographic and bedrock elevation lines are for illustrative puposes only and do not represent actual conditions